3/6 net. [No. 37.
...ance in JULY. Title and Index
... 4/- net, for the Volume
... 7/6 net, post free.

# ...ritish ...ournal of Surgery

UNDER THE DIRECTION OF THE FOLLOWING
...IAL COMMITTEE:

... K.C.M.G., C.B. (Leeds), *Chairman.*
Sir WM. ARBUTHNOT LANE, Bt., C.B. (London)
Sir ALEXANDER MacCORMICK (Sydney)
Sir GEORGE H. MAKINS, G.C.M.G., C.B., LL.D (London)
HENRY A. MOFFAT, D.S.O. (Capetown)
RUTHERFORD MORISON (Newcastle-on-Tyne)
Sir THOMAS MYLES, C.B. (Dublin)
R. H. PARRY (Glasgow)
Sir D'ARCY POWER, K.B.E. (London)
SIDNEY W. F. RICHARDSON (Capetown)
JAMES SHERREN, C.B.E. (London)
GRAHAM S. SIMPSON (Sheffield)
THOMAS SINCLAIR, C.B. (Belfast)
Sir HAROLD J. STILES, K.B.E. (Edinburgh)
Sir J. LYNN-THOMAS, K.B.E., C.B., C.M.G. (Cardiff)
HENRY ALEXIS THOMSON, C.M.G. (Edinburgh)
Sir WILLIAM THORBURN, K.B.E., C.B., C.M.G. (Manchester)
GEO. GREY TURNER (Newcastle-on-Tyne)
GEORGE E. WAUGH (London)
Sir W. L. de COURCY WHEELER (Dublin)
...tol), *Editorial Secretary.*

...Y, 1922

...WRIGHT & SONS LTD.
... SIMPKIN, MARSHALL, HAMILTON, KENT & CO. LTD.
... MACMILLAN CO. OF CANADA LTD.
... THACKER, SPINK & CO. BOMBAY: W. THACKER & CO
... NEW ZEALAND: WHITCOMBE & TOMBS LTD.
... WILLIAM WOOD & CO. NEW YORK, *Sole Agents.*
... New York, N.Y., under the Act of March 3, 1879 (Sec. 416, P. L. & R.).

HANBURYS LTD., LONDON.

THE
BRITISH JOURNAL OF SURGERY

VOL. X. JULY, 1922. No. 37.

# *EPONYMS.*

BY SIR D'ARCY POWER, K.B.E., LONDON.

## V. SIR JAMES PAGET.

THE name of Sir James Paget is associated with a disease of the nipple and with a remarkable change in the skeleton to which he gave the name of 'osteitis deformans'. It is noteworthy that the true pathology of neither of these conditions has yet been worked out.

### ON DISEASE OF THE MAMMARY AREOLA PRECEDING CANCER OF THE MAMMARY GLAND.

The paper on "Paget's Disease of the Nipple", as it is now commonly called, appears in the tenth volume of *The St. Bartholomew's Hospital Reports* for the year 1874, pages 87–9. As a classical contribution to surgery it is even shorter than Abraham Colles's description of the fracture of the wrist with which his name is now associated.

Paget writes: "I believe it has not yet been published that certain chronic affections of the skin of the nipple and areola are very often succeeded by the formation of scirrhous cancer in the mammary gland. I have seen about fifteen cases in which this has happened, and the events were in all of them so similar that one description may suffice.

"The patients were all women, various in age from 40 to 60 or more years, having in common nothing remarkable but their disease. In all of them the disease began as an eruption on the nipple and areola. In the majority it had the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed; like the surface of a very acute diffuse eczema, or like that of an acute balanitis. From such a surface, on the whole or greater part of the nipple and areola, there was always copious, clear, yellowish, viscid exudation. The sensations were commonly tingling, itching, and burning, but the malady was never attended by disturbance of the general health. I have not seen this form of eruption extend beyond the areola, and only once have seen it pass into a deeper ulceration of the skin after the manner of a rodent ulcer.

"In some of the cases the eruption has presented the characters of an ordinary chronic eczema, with minute vesications, succeeded by soft, moist, yellowish scabs or scales, and constant viscid exudation. In some it has been like psoriasis, dry, with a few white scales slowly desquamating; and in both these forms, especially in the psoriasis, I have seen the eruption spreading far beyond the areola in widening circles, or, with scattered blotches of redness, covering nearly the whole breast.

"I am not aware that in any of the cases which I have seen the eruption was different from what may be described as long-persistent eczema, or psoriasis, or by some



gen

other name, in treatises on diseases of the skin; and I believe that such cases sometimes occur on the breast, and after many months' duration are cured, or pass by, and are not followed by any other disease. But it has happened that in every case which I have been able to watch, cancer of the mammary gland has followed within at the most two years, and usually within one year. The eruption has resisted all the treatment, both local and general, that has been used, and has continued even after the affected part of the skin has been involved in the cancerous disease.

"The formation of cancer has not in any case taken place first in the diseased part of the skin. It has always been in the substance of the mammary gland, beneath or not far from the diseased skin, and always with a clear interval of apparently healthy tissue.

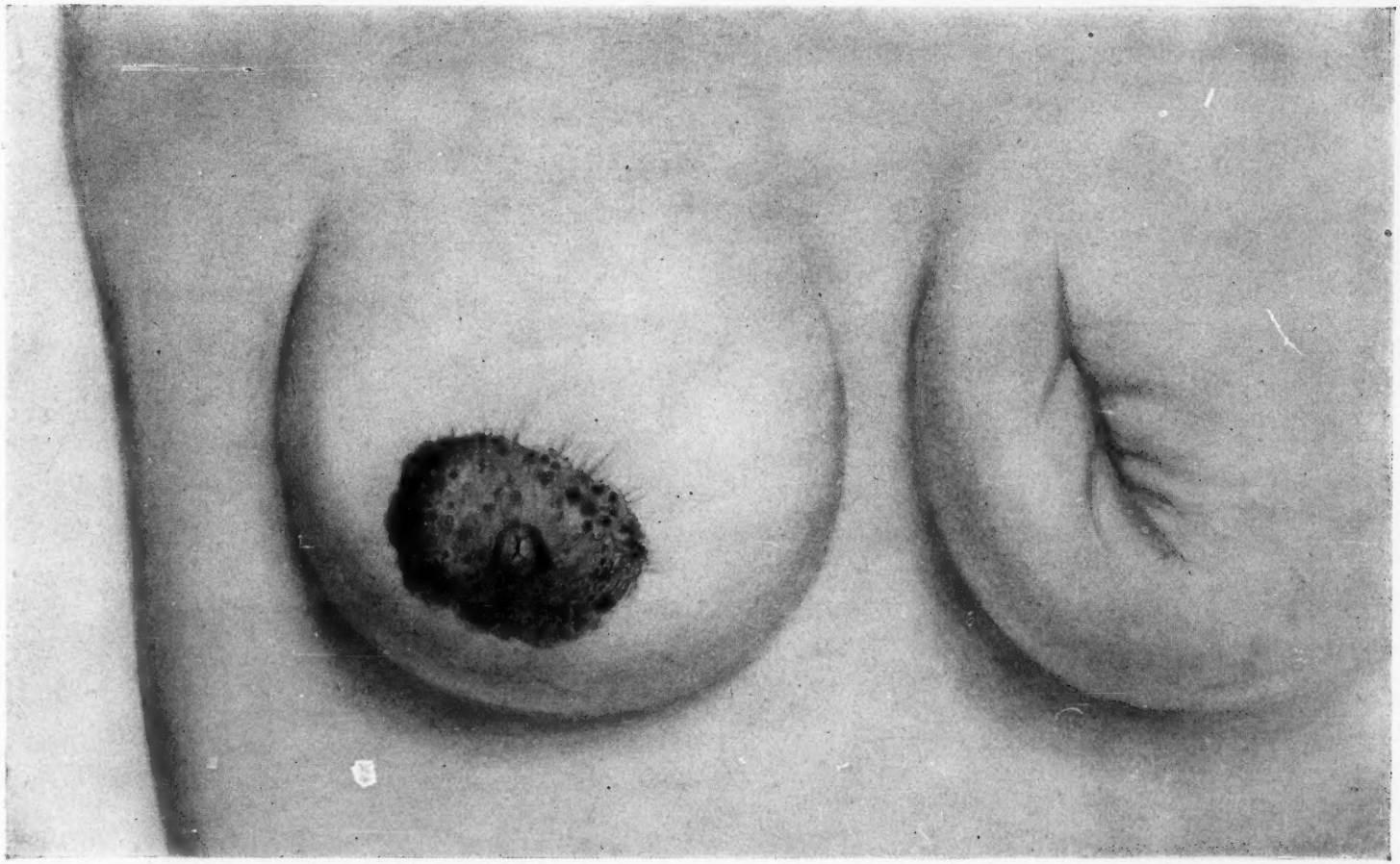
"In the cancers themselves, I have seen in these cases nothing peculiar. They have been various in form; some acute, some chronic, the majority following an average course, and all tending to the same end; recurring if removed, affecting lymph-glands and distant parts, showing nothing which might not be written in the ordinary history of cancer of the breast.

"The single noteworthy fact found in all these cases is that which I have stated in the first sentence, and I think it deserves careful study. For the sequence of cancer after the chronic skin-disease is so frequent that it may be suspected of being a consequence, and must be always feared, and may be sometimes almost certainly foretold. I believe that a nearly similar sequence of events may be observed in other parts. I have seen a persistent 'rawness' of the glans penis, like a long-enduring balanitis, followed after more than a year's duration by cancer of the substance of the glans. A chronic soreness or irritation (of whatever kind) on the surface of the lower lip often long precedes cancer in its substance; and, with a frequency surpassing all other cases of the kind, the superficial syphilitic diseases of the tongue are followed, and not superseded, by cancers which do not always appear to commence in a diseased part of the tongue.

"For an explanation of these cases it may be suggested that a superficial disease induces in the structures beneath it, in the course of many months, such degeneracy as makes them apt to become the seats of cancer; and that this is chiefly likely to be observed in the cases of those structures which appear to be, naturally, most liable to cancer, as the mammary gland, the tongue, and the lower lip. One may suspect that similar surface-irritation has much to do with the frequency of cancer of the rectum, pylorus, and ileo-cæcal valve, in any of which parts the degeneracy, which might come naturally in old age and make them apt for cancer, may be hastened, and made prematurely sufficient, by an adjacent disturbance of nutrition.

"In practice, the question must be sometimes raised whether a part through whose disease or degeneracy cancer is very likely to be induced should not be removed. In the member of a family in which cancer has frequently occurred, and who is at or beyond middle age, the risk is certainly very great that such an eruption on the areola as I have described will be followed within a year or two by cancer of the breast. Should not, then, the whole diseased portion of the skin be destroyed or removed as soon as it appears incurable by milder means? I have had this done in two cases, but I think too late. Or, again, when one with a marked family-liability to cancer has syphilitic disease of the mucous membrane of the tongue, with frequent recurrences of inflammation; should not all the worst pieces of the membrane be removed? I should certainly advise it, especially if the membrane were ichthyotic, if it were not that the disease is commonly so extensive that good scar-tissue would not be likely to be formed, and that bad scar-tissue, often irritable and ulcerating, is as likely to induce cancer as the syphilitic or ichthyotic patches would have been."

The publication of this paper proved a matter of interest both clinically and pathologically. Those who saw the actual cases and followed up the subsequent course of similar ones were clear that this form of chronic inflammation did not always end in cancer, and that, as Paget stated, local excision was sometimes followed by cure. It was



Eczema of the nipple in the right breast, occurring three years after removal of the left breast for scirrhus.

*From a drawing by Thomas Godart, March,* 1884,
*in the Museum of St. Bartholomew's Hospital*

recognized, however, that cancer occurred very frequently, and the condition was looked upon as ' precancerous'.

The present view held by the majority of surgeons is that cancer of the breast precedes the eczema of the nipple and causes it. Mr. Sampson Handley presents this explanation in the following words (*The British Journal of Surgery*, 1919–20, vii, 189): "A carcinoma starts in the smaller ducts of the breast, perhaps exceptionally from the acini or the larger ducts. Usually, without producing a palpable tumour, it permeates the breast lymphatics widely. The rich plexus of lymphatic vessels around the ducts forms an especially easy and convenient channel for permeation, and the lymphatic block extends along them to the subareolar plexus beneath the nipple. The cutaneous lymphatics about the nipple are now dammed up so that lymph cannot return from them. Later they are themselves permeated, but possibly this is not always the case. At this stage, and before any lump has appeared in the breast, the skin of the nipple and the mucosa of the ducts begin to show changes dependent upon lymphatic obstruction. The epithelium shows disintegration and degeneration of its superficial layers, with proliferation of the deeper layers. These changes are nutritional and non-malignant. The dermis becomes thickened by solid lymphatic œdema. . . . In the rare cases where no carcinoma has made its appearance, though the Paget's disease has lasted many years, it is probable that an atrophic scirrhus, which may have undergone partial or complete cure, preceded the onset of the Paget's disease. But the possibility that the lymphatic obstruction in such cases is of inflammatory origin, and due to a chronic lymphangitis, cannot be altogether excluded."

It will be noticed that Paget's original paper dealt entirely with the clinical aspects of the disease. In 1875—a year after the publication of the memoir—the histological details of two similar cases were described in *The Medico-Chirurgical Transactions*, lix, 107, by Butlin, who added two more in the course of the following year.

Matters rested there for some years, and, as the disease is rare, little notice was taken of it until, on June 4, 1890, Louis Wickham read as his thesis for the Doctorate of Medicine at Paris a "Contribution à l'Étude des Psorospermoses cutanées et de certaines Formes de Cancer Maladie de la Peau dite Maladie de Paget". The thesis opened with the bold statement, "La maladie de Paget est une affection parasitaire du groupe des psorospermoses cutanées, caractérisée par l'inflammation chronique de la peau, des glandes et de leurs conduits, suivie de prolifération épithéliale". ("Paget's disease is parasitic, the result of cutaneous psorosperms, and characterized by a chronic inflammation of the skin, glands, and ducts associated with epithelial proliferation".) The thesis, which was clearly inspired by Darier, who was the head of the Laboratory at the Hôpital Saint Louis, quickly attracted attention throughout Europe and America, and the battle of cancer parasites raged round Paget's disease of the breast for several years. Many observers claimed to have discovered the true parasite of cancer; but no two agreed upon the same, and after a few years the controversy died away. It proved of lasting value, however, because it led skilled histologists to investigate the changes—degenerative and otherwise—which take place in epithelial cells, and many forms of cell-inclusion, vacuolation, and œdematous change became familiar.

The plate of ' Paget's disease of the Nipple ' is made by the kind permission of the Treasurer and Governors of St. Bartholomew's Hospital, from a water-colour sketch of a patient sent to the Hospital by Sir James Paget in 1884. The drawing is No. 1057 in the Museum of St. Bartholomew's Hospital.

*(To be continued.)*

# REMOVAL OF INTRATHORACIC TUMOURS BY THE TRANS-STERNAL ROUTE.

By T. P. DUNHILL, C.M.G., London.

Large intrathoracic tumours are seldom successfully removed in their entirety, and this seems to justify the publication of the first of the cases here recorded. Two cases of intrathoracic enlargements of the thyroid gland are added, because their depth and position in the mediastinum made it necessary that they should be approached by an unusual route.

In all three instances the tumours were removed through an incision which split the upper half of the sternum. This method of approach had been practised by Professor G. E. Gask before the war. During the war, and subsequently in civil work, this operator has been perfecting methods of access to the thoracic cavity designed to give more efficient working room.[1] A trans-sternal route had also been used by Pierre Duval in order to reach the right auricle and inferior vena cava ; but for this purpose he split the lower half of the sternum.[2] By this means he removed a bullet which kept moving to-and-fro in a disconcerting fashion between the patient's great vessel and heart. Lilienthal removed a mediastinal thyroid by the trans-sternal route.[3]

In each of the following three cases urgent necessity compelled intervention, unless the patients were to be left to their fate. The difficulty of respiration had reached a degree which, in the first case, was incompatible with exertion ; and in the other two was rapidly becoming incompatible with life.

Dr. J. H. Drysdale has kindly supplied the following notes of *Case* 1.

*Case* 1.—" E. T. P., age 35, male, was sent to me by Dr. von Bergen on Dec. 2, 1920, with ' symptoms of intrathoracic pressure '.

" The patient was in his usual good health till March, 1915, when he had an attack of 'influenza' with pulmonary catarrh. In Nov., 1916, and again in April and Oct., 1917, he had similar attacks. From Dec., 1918, to Feb., 1919, he had a prolonged illness with fever, occasionally reaching 102° ; much sputum, and violent cough. Three examinations of the sputum for T. B. were all negative. In March, 1919, he had a course of vaccines, and thereafter had been free from catarrhal symptoms, and expectoration entirely ceased. In June, 1919, however, dyspnœa—increased by exertion—became noticeable, and persisted up to the time of examination.

" Recently had suffered from 'rheumatism', chiefly in the right arm. Not losing weight.

" On Examination.—Cyanosis of the head and neck, and upper extremities. The right upper arm was 1¼ in. larger in circumference than the left, and the forearm ¾ in. There was no pitting of the subcutaneous tissue nor any obviously enlarged veins. Hanging down, the right arm is distinctly bluer than the left. The skin of the right arm and hand was quite dry and almost scaly. The patient stated that he had not sweated (or hardly at all) in that arm for *twelve or fourteen years*. The grip of the right hand is feebler than that of the left. The radial pulses were equal, as were the pupils. There was no obvious deflection of the trachea, nor a tracheal tug. Chest : no abnormal pulsation could be seen or felt. On the right side, from the apex down to about the 3rd rib the percussion note was considerably impaired, the impairment reaching almost to the left border of the sternum. Similar signs present over a rather larger area behind. The breath-sounds were slightly stridulous on both sides, the amount of air entering being somewhat less on the right side than on the left.

" The signs pointed to the presence of a tumour occupying the mediastinum and upper part of the thorax on the right side. The symptoms, especially the prolonged absence or deficiency of sweating of the right arm, suggested some very slowly progressing lesion. Hydatid cyst or teratoma were considered to be the most likely alternatives. An operation was advised."

Shortly after being seen, and before any further examination could be carried out, the patient had another attack of pulmonary catarrh and was for some days in a condition of great danger.

Wassermann's reaction, negative. Blood-count, normal.

An *x*-ray picture was taken by Dr. G. Harrison Orton on Jan. 12, 1921 (*Figs.* 1, 2). On Jan. 27 he was seen by Dr. J. Perkins, who agreed with the diagnosis of mediastinal tumour, and also advised operation.

OPERATION.—An operation was planned which would enable an osteoplastic flap to be raised, access to the upper part of the right thoracic cavity being thus obtained. This flap was to include the right half of the sternum, from the suprasternal notch to the third intercostal space, together with the clavicle and the three upper costal cartilages and ribs.

This operation was performed on Feb. 19, Mr. Geoffrey Keynes assisting me. An intratracheal anæsthetic of gas and oxygen, passed through detoxicated ether, was given with Kelly's

FIG. 1.—*Case* 1. Intrathoracic fibroma. Antero-posterior view.

apparatus by Mr. C. Langton Hewer. A skin incision was made as shown in the photograph (*Fig.* 3). The upper limb of the incision was the same as that used for a goitre operation, because in the present case the opacity of the tumour had been seen in the *x*-ray photographs to extend higher than the right clavicle (although nothing could be felt in the neck), and it was therefore necessary first to make certain that it was not an intrathoracic goitre. The lower limit of the tumour was as low as the third interspace; but goitres sometimes descend as low as this (*Case* 2, *Fig.* 8). The lower border of the thyroid gland was found to be unconnected with the tumour. From the centre of the incision in the neck a vertical incision was made over the middle of the sternum down to the level of the articulations of the fourth costal cartilages, and was then continued outwards to the right over the fourth rib for about five inches. The sternum was divided in the line of the

vertical incision and to the right, into the third interspace (*Fig.* 4), the intercostal muscles being also cut to the extent of the skin incision. The internal mammary vessels were ligatured and cut above and below, and the osteoplastic flap could then be raised.

Access to the tumour was thus obtained. It was crossed by the junction of the right internal jugular and subclavian veins, and these had to be manipulated out of the way. The mass filled the dome of the right thoracic cavity so completely that it had displaced the pleura downwards and was fairly easily separated from this below. The tumour could then be defined, and it was found that there was barely room for a flat hand to work round between it and the ribs laterally. Behind, it was closely applied to the ribs, and mesially it appeared to be firmly attached to the

FIG. 2.—*Case* 1. Intrathoracic fibroma. Lateral view, to show depth in the thorax.

bodies of the vertebræ, in front of which its lower part seemed to be in contact with the base of the heart and the great vessels. Anteriorly it would have reached the chest wall but for the fact that this was lifted up and retracted away from it. Its lower convexity was overlapped by an edge of the right lung.

Since the mesial aspect of the tumour appeared to be firmly fixed, it seemed unwise to try to separate it without first obtaining the patient's permission to take the evident risk. Any tearing of the great vessels would have resulted in uncontrollable hæmorrhage. The osteoplastic flap was therefore replaced and sutured in position.

A month later, March 24, permission having been given to proceed, the wound was re-opened in the same fashion as before. On this occasion Mr. S. L. Higgs assisted me, and an intratracheal

anæsthetic was given by Dr. Magill. This form of anæsthesia prevented any collapse of the lung from taking place when the thorax was opened, and gave perfectly regular and comfortable breathing throughout the operation. Gradually the tumour was separated from its surroundings by working first on one side and then on another, until it appeared to be free except for an attachment to the periosteum covering the body of a vertebra. This was broken through, and the tumour lifted out of the thorax. At the site of attachment there was some bleeding from a leash of vessels; this was ligatured. When the tumour was removed, an area on the body of a vertebra was seen to be bare of periosteum. The induration of the pleura resulting from the traumatism of the first operation prevented the lung from expanding at once, so that a huge cavity remained. The

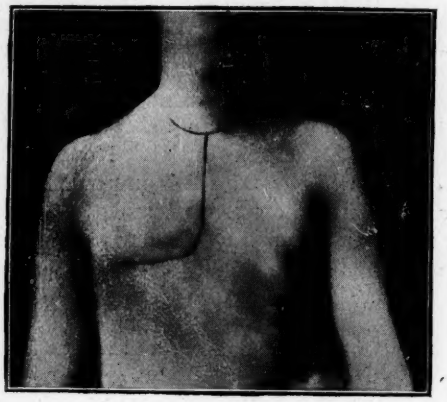


FIG. 3.—*Case* 1. To show the incision.

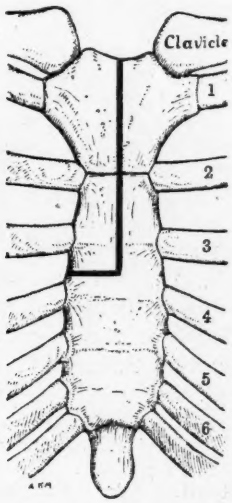



FIG. 4.—*Case* 1. Line of division of sternum.

osteoplastic flap was replaced and sutured accurately in position without drainage. The wound healed and, except for some aching in the arm, the patient's convalescence was uneventful. An

FIG. 5.—*Case* 1. Four-and-a-half weeks after removal of tumour. Fluid in cavity.

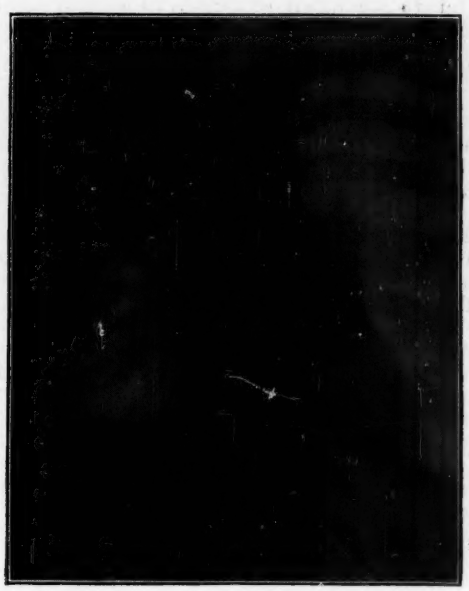


FIG. 6.—*Case* 1. Nine months after removal of tumour. Fluid absorbed. Lung expanded.

*x*-ray examination by Dr. Harrison Orton on April 28, four and a half weeks after the operation, showed that the cavity was not yet obliterated, and that it contained fluid half an inch in depth

when the patient was standing (*Fig.* 5). Free movement of the fluid could be seen at its surface. A second examination on Nov. 29 showed that all the fluid had disappeared and the lung had fully expanded (*Fig.* 6). The patient is now quite well, and is carrying on his business.

DESCRIPTION OF THE TUMOUR.—A pathological examination of the tumour was made by Sir Frederick Andrewes and Mr. Geoffrey Keynes. It was found to be a very firm, rounded, encapsulated mass (*Fig.* 7). It measured about 13¾ cm. in its greatest diameter, and weighed 560 grm. (1 lb. 3½ oz.). The capsule showed signs of having been torn away from an area of attachment about 2 cm. in diameter. The tumour as a whole was relatively avascular. Microscopic sections made from several different parts of the tumour, including the area of attachment, showed that it was composed wholly of fibrous connective-tissue. There were some opaque yellow areas of necrosis and a few small patches of round-celled infiltration, but there was no evidence of malignancy. Differential staining did not reveal any sign of nervous tissue at any point. The tumour is therefore seen to be a fibroma of unusually large size. It may have started as a 'false neuroma' in the sheath of one of the segmental nerves close to the spinal column; but there is no longer any histological proof of this. Alternatively it may have arisen from a ligament or the periosteum of the spinal column.

I have taught and written hitherto that intrathoracic tumours arising from the thyroid gland can always be removed through the upper thoracic outlet. Nevertheless *Cases* 2 and 3, now to be recorded, illustrate conditions which render this impossible. In the first, there were dense adhesions in the neck and behind the sternum, and the tumour was placed deeply in the thorax. In the second, adhesions, seen in the *x*-ray photograph, were binding the tumour firmly to the aortic arch and to other structures in the neighbourhood.

*Case* 2.—Dr. Hector Mackenzie asked me to see this patient in consultation, and he has kindly written the following notes.

"The patient, a married woman, was sent to me by Dr. Ind, of Sittingbourne, in June, 1911. She was then 42 years of age, and had had a swelling in her neck for four years. She had a moderate-sized goitre, chiefly affecting the left side. It was smooth, and free from nodules. It seemed to extend behind the sternum. It was obviously producing pressure on the veins and on the trachea. The veins were prominent over the manubrium. There was some stridor; and shortness of breath and cough were induced by exertion. She was admitted to hospital.

"A first attempt to remove the goitre was unsuccessful. The left lobe of the thyroid was found to be much enlarged, to extend behind the sternum, and to compress the trachea laterally. The operation was followed by bronchitis, and congestion of the base of the right lung. *X*-ray examination showed the trachea deflected to the right at the root of the neck, and a shadow was seen projecting from behind the manubrium on both sides, but more on the left.

"A second attempt was made to remove the growth on Dec. 1. The lower limits of the tumour could not be reached. Profuse hæmorrhage followed the endeavour, and it was considered too dangerous to proceed further. Two and a half hours later the patient was blue, dyspnœic, and unconscious, and Mr. Max Page, who was then Resident Assistant Surgeon, opened up the wound with the intention of performing tracheotomy. The trachea, however, could not be located, and the symptoms being most urgent, the growth was seized between the fingers and pulled on, when part of it came away. More of the growth was then enucleated: altogether a mass the size of a large duck's egg was removed. As the dyspnœa was relieved, tracheotomy was not performed. After this the patient remained very ill for some weeks with high temperature and rigors, but she eventually was able to leave the hospital on Feb. 3, 1912.

"The laboratory report on the mass was that it was thyroid carcinoma. I think the subsequent history shows that this was not the case. The removal of part of the goitre relieved the patient for a time, and I did not see her again until Aug., 1917. Her principal difficulty then was a troublesome cough. The palpable part of the thyroid seemed only slightly larger than normal. There were still signs of intrathoracic pressure. In Oct., 1921, I saw her once more. She was now a good deal worse. Cough had been very troublesome both in summer and winter. There was stridor and dyspnœa. The veins were very prominent over the upper part of the thorax, especially on the left side. It seemed to me that another attempt should be made to remove the intrathoracic goitre, but I felt a good deal of responsibility in advising the patient to undergo a third operation. She was very anxious to obtain relief."

When seen by me she was obviously in great distress. Every breath was laboured, and breathing was only made possible at all by holding the head in a particular position in relation to the chest. A small adenoma of the thyroid could be felt on the right of the neck, but this was unconnected with the intrathoracic tumour. The tissues of the neck immediately above the sternum were matted together by the scarring of the previous operations. There was a close network of dilated veins all over the upper part of the front of the chest, neck, and both arms. The face was cyanosed.

FIG. 7.—Intrathoracic fibroma. Showing where the capsule of the tumour was attached to the vertebra.
(*Natural size.*)

An *x*-ray photograph (*Fig.* 8), taken by Dr. Dudley Stone, showed a "large tumour in the superior mediastinum, reaching from above the clavicles down to the level of the seventh dorsal vertebra. It extended outwards for about 4 cm. on either side of the sternum, backwards to the vertebral column,* and forwards almost to the sternum." Although the tumour could be seen in the photograph to extend up into the neck, none of it could be felt or detected at this level. Operation afterwards showed that this part was entirely hidden behind

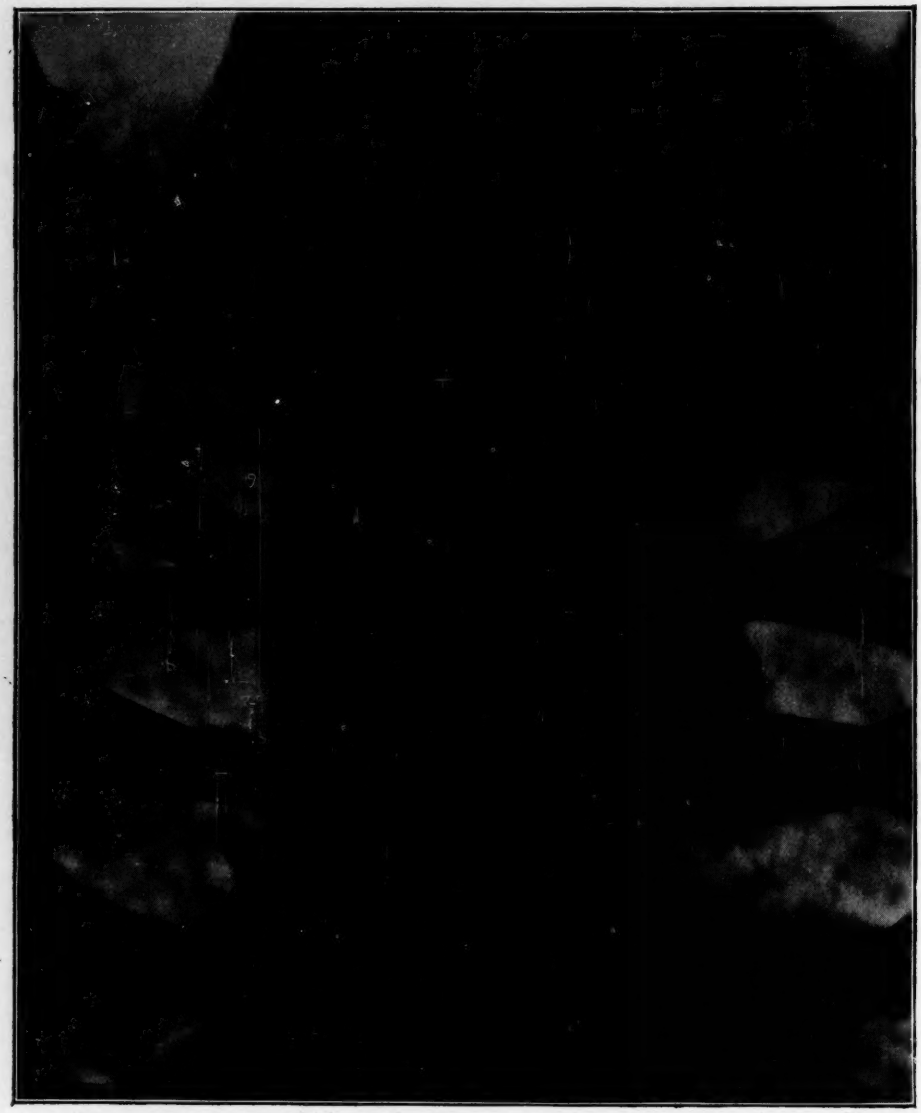


FIG. 8.—*Case* 2. Antero-posterior view. On the plate the trachea is seen encircling the right side of the tumour.

the trachea and œsophagus. The outline of the tumour was distinct from that of the arch of the aorta, which was pushed downwards and to the left. The trachea was displaced backwards and to the right and was narrowed antero-posteriorly as well as from side to side, that is to say it was compressed obliquely. The tumour descended below the bifurcation of the trachea. It was, therefore, very deeply placed, and the upper thoracic outlet was closed by scar

* At operation it was found to extend far back in the paravertebral space on the left side, as well as across the vertebræ to the right.

tissues as by a lid. These conditions quite precluded any possibility of lifting it out in the ordinary way.

OPERATION, Nov. 24.—As already seen, the tumour flattened and displaced the trachea, and extended beyond its division. There was also the possibility that even the slight irritation of the trachea produced by the introduction of a catheter might prove fatal. It was, therefore, not advisable to give an intratracheal anæsthetic, but to use an open method, the head being held throughout the operation in the position which the patient had proved for herself to be the only possible one. The anæsthetic was administered by Mr. C. Langton Hewer. Mr. Geoffrey Keynes assisted me at the operation.

The sternum was divided longitudinally as in the first case, but in this instance it was necessary to cut out along the third intercostal space on both sides in order to obtain sufficient access. The sternum was thus divided completely across (*Fig.* 9), and each side of the anterior thoracic wall was lifted up—opening double doors, as it were. Even when this had been done, it was only after the whole hand had been introduced into the chest from the lower end of the division in the sternum that the lower and hinder part of the tumour could be reached and lifted forwards. The upper part was buried in dense adhesions, due to previous operations, these adhesions extending to well below the level of the upper border of the sternum. The tumour was separated and removed intact. The patient felt immediate relief, and her convalescence was uninterrupted. She is now quite well.

The tumour was an elongated colloid adenoma of the thyroid, with rounded ends and an impression on one surface corresponding to the position of the arch of the aorta. It was 14 cm. long, 6 cm. thick, and weighed 307 grm. (11 oz.).*

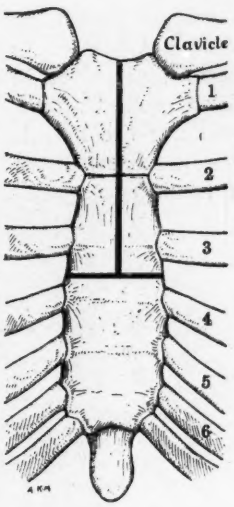



FIG. 9.—*Case* 2.
Line of division of sternum.

*Case* 3.—The last case, Mr. M., a patient of Dr. Trapnell, Beckenham, was a gardener, a very frail man, age 66, referred to me by Mr. F. Rose at St. Bartholomew's Hospital. This patient had apparently had an intrathoracic cystic adenoma of the thyroid for a long time. As in the former case, attempts had been made to remove it ten years before, but had failed. It was then drained, and fluid material was discharged through a sinus for nine and a half years. Six months ago the discharge had ceased. Following on this, dyspnœa had commenced, and had become progressively more distressing. Admission to hospital had become a matter of urgency on account of the patient's rapidly increasing symptoms. The only possibility of relief was by the removal of the tumour.

In the former case the tumour had been entirely within the thorax, and there was no possibility of removing it through the neck. Generally, when the tumour is only an extension of an enlargement of the thyroid in the neck, it pushes its way down into the mediastinal tissues, which form around it an adventitious capsule. From this it may be shelled out with the greatest ease. Sometimes, however, a thoracic extension of this kind is not free below, and so cannot safely be lifted out from above, either with the fingers or with mechanical assistance.

In the present case the prolonged suppuration had given rise to chronic inflammation round the tumour, and to firm adhesions. These were particularly well marked between the lower pole of the tumour and the arch of the aorta—the tumour very considerably overlying the aorta—and were seen in the *x*-ray photograph. At operation, April, 1921, the sternum was split, in this case under local anæsthesia, in the usual way, and access to the tumour was good. It was, however, so firmly fixed by the adhesions at its lower pole that it could only be removed by dividing them, partly by dissection, partly by gently separating. The pulsations of the aorta could be felt directly under the finger all the time, and presumably there were other structures involved, equally important but less easily recognized.

---

* Since the above article was written, this patient began to have pain and difficulty in swallowing. *X*-ray examination showed a spherical opacity 12 cm. in diameter in the chest, with its centre behind the articulation of the third costal cartilages with the sternum. At first I thought this was fluid, distending the cavity from which the tumour had been removed. Exploration showed it to be neoplastic; the microscopical section having the appearance of spindle-cell sarcoma. Sections were then cut from the tumour removed on Nov. 24, 1921. This also was proved to be sarcoma. This is the only tumour removed by me which has not been examined microscopically at the time of removal; the reason being that it was encapsuled and an excellent specimen of a completely intrathoracic tumour, and it was desired to preserve it as such. The length of history—at least fourteen years—had seemed to exclude malignancy. The diagnosis in 1911 was carcinoma. The portions removed in 1921 and 1922 are undoubtedly sarcoma; the sections are available for examination.

It is possible that the 1911 tumour was of the nature of a fœtal adenoma. It is difficult to believe that a sarcoma could have existed for that length of time. In this connection the article by L. B. Wilson, of the Mayo Clinic, in the *Annals of Surgery*, August, 1921, is extremely interesting.

Examination of the tumour after its removal showed that it consisted of a thick fibrous wall, in which no thyroid tissue could be found. It contained broken-down débris. Cultures made from this showed no growth.

Dr. Trapnell writes me, Jan. 25, 1922, that this patient is well as regards his thorax, and the breathing is quite comfortable. He has had a severe attack of nephritis since, and has osteo-arthritis in one hip.

Any growth infiltrating within the thorax almost certainly cannot be removed, but it is not always possible to distinguish these growths from innocent tumours before operation. Even in dealing with innocent tumours the anatomical relations may be such as to make thorough exploration a matter of some danger. *X*-ray examination will show whether the margin is clearly defined: if it is, and if aneurysm can be excluded with reasonable assurance, there is the possibility that the tumour may be a fibroma, lipoma, dermoid cyst, goitre, or hydatid cyst.

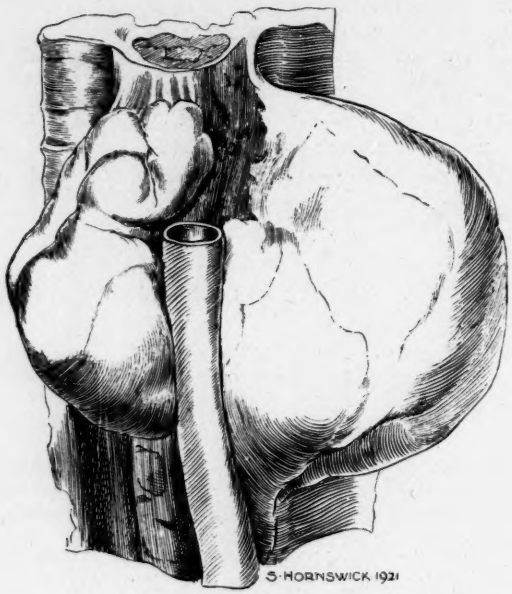



FIG. 10.—Fibromyxoma. Dr. Morley Fletcher's case.

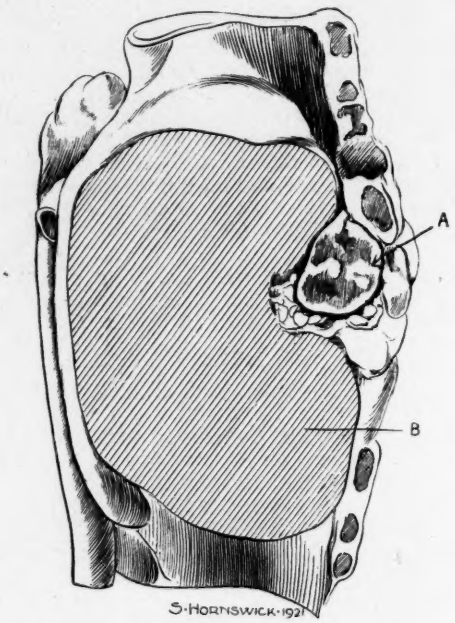



FIG. 11.—Section of specimen seen in *Fig.* 10. **A**, Site of origin of malignant growth (sarcoma). **B**, The mass of the growth is fibromyxoma.

It may be objected that there will be more danger to the patient in attempting to remove these, when large and deeply situated, than in leaving them alone. There are two main arguments against this view: (1) The dyspnœa, which in almost every recorded case has ultimately caused death; and (2) The possible occurrence of a malignant change in an innocent tumour. The first of these arguments is well illustrated by a case reported by Dr. Leopold.[4] His patient, a man, age 37, suffered from a persistent cough of increasing severity. It was accompanied by shortness of breath and, later, by pronounced dyspnœa. The physical signs and *x*-ray examination nine months after the onset of the symptoms showed that there was a tumour filling about four-fifths of the chest. There was no pain, difficulty in swallowing, alteration in voice, or loss of weight, but the slightest exertion produced distressing attacks of embarrassed breathing. Death, after about fifteen months' illness, was preceded by numbness of the arms, mental torpor, and, finally, a struggle for air. The necropsy showed that the thoracic cavity was almost filled by a lobulated mass which compressed the lungs against the vertebral column. This was found to consist of pale yellowish fatty tissue. It weighed 17 lb. 6 oz., and measured 31 by 30 by 15 cm.

Although several cases of the other tumours mentioned above have been recorded, only four more cases of mediastinal lipoma could be found by Dr. Leopold in the literature.[4] Three of these ended fatally through increasing dyspnœa. The fourth, of the size of a tangerine orange, presented above the sternum, and was removed by Beatson of Glasgow. The seven fibromata recorded by Hare[5] in the Fothergillian Prize Essay all ended fatally.

In relation to the second possibility mentioned, namely malignant change, Dr. Morley Fletcher's case is interesting. The specimen (*Figs.* 10, 11) is now in St. Bartholomew's Hospital Museum, and is described in the catalogue as: "A large bi-lobed tumour of the posterior mediastinum, extending from the body of the sixth to that of the eleventh dorsal

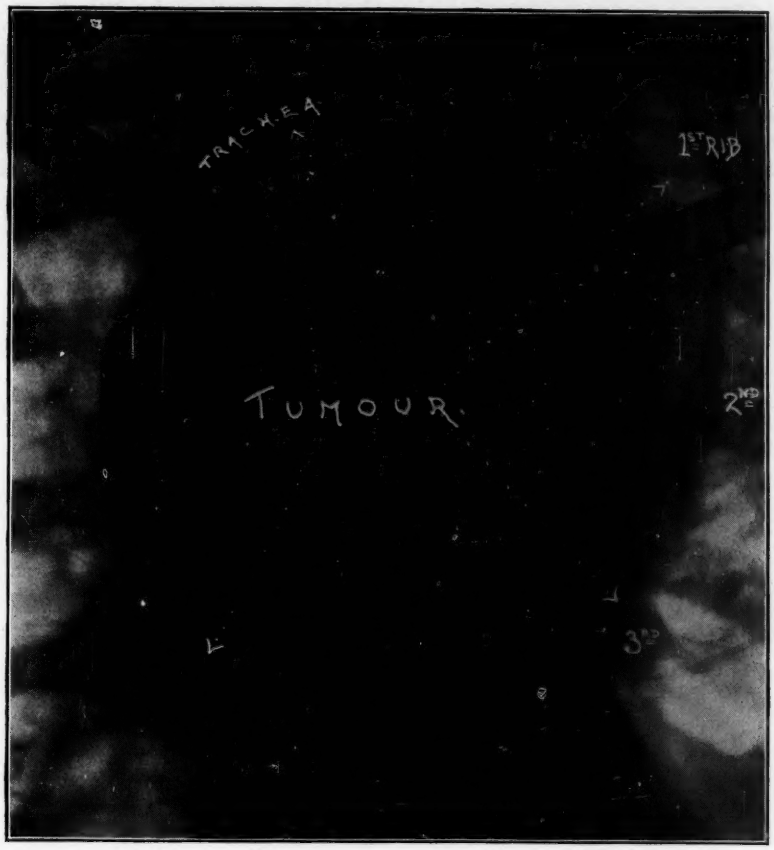



FIG. 12.—Aneurysm. The vertical limit is the same as the tumours in *Cases* 1 and 2.

vertebra. Lying behind the tumour on the left side are portions of the 7th, 8th and 9th ribs, which are invaded by a hæmorrhagic growth of totally different appearance. The bi-lobed tumour consists mainly of myxomatous and fibrous tissue with some nerve fibres and scattered groups of large round cells resembling sympathetic nerve-cells. The hæmorrhagic part of the growth invading the ribs, and also that found in the bodies of the vertebræ, is a small spindle-celled sarcoma" (Specimen 2561B). The Committee on Morbid Growths (Hebb and Shattock) classed the primary growth as a fibromyxoma, since they did not regard the presence of nerve tissues as an integral feature of the new formation. They believed the nerve-cells to belong to sympathetic ganglia which had become involved. It is reasonable to suppose that in this case the fibromyxoma had been in existence for a long time. Sarcomatous change occurred in it, at first in a small

area well marked off from the remainder of the tumour, but invading surrounding structures later, and ultimately killing the patient. It is worth noting the points of origin of this tumour and of the very similar growth recorded here in *Case* 1. In the present case the tumour apparently arose in, or in close proximity to, the sympathetic cord. In *Case* 1 the only point of attachment seemed to be on the side of the body of one of the dorsal vertebræ, in close proximity to the sympathetic cord.

In another patient, a tumour having pathological characters exactly similar to those of the growth in *Case* 1 blocked the outlet of the pelvis. It was 9 cm. in diameter, and prevented the delivery of a child, which Dr. Donaldson extracted by Cæsarean section. I afterwards removed the tumour, a retroperitoneal fibroma, and its point of attachment was seen to be at the first sacral foramen on the right side. These three tumours of identical structure had, therefore, analogous sites of origin along the vertebral column.

Sometimes it is very difficult to diagnose an aneurysm from other mediastinal tumours. An example of this is illustrated in *Fig.* 12. The patient suffered from symptoms almost identical with those of *Case* 1 and of Dr. Leopold's case of massive lipoma. Dyspnœa on exertion was the only complaint. There was no pain at all, and no discomfort as long as the patient took things quietly. For many months there was no expansile pulsation to be seen on the *x*-ray screen. The Wassermann reaction, however, was positive, and there was an indefinite tracheal tug. This induced those of us who were associated with the case to watch it carefully for a period extending over ten months. Then the dyspnœa increased. On screen examination the tumour appeared larger, and expansile pulsation was now obvious.

Fear of the unknown within the thorax has hitherto made us pause in dealing with tumours in this part of the body, even when the condition of the patient was distressing and dangerous. A greater familiarity is tending to remove our fear; but the last case recorded in this article emphasizes the necessity for an accurate diagnosis before a decision to explore finally prevails.

---

REFERENCES.

[1] Lettsomian Lectures, *Med. Soc. of London*, 1921.
[2] *Presse méd.*, 1918, xxvi, 437.
[3] Lilienthal, *Surg. Gynecol. and Obst.*, 1915, xx, 589.
[4] *Arch. of Internal Med.*, 1920, Sept. 15.
[5] *Med. Soc. of London*, 1899.

# LATE RESULTS OF MANIPULATIVE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP.

By E. LAMING EVANS, C.B.E., London.

In reporting upon a series of 49 cases of congenital dislocation of the hip, involving 61 joints, treated by me between 1903 and 1916 inclusive, at the Royal and Royal National Orthopædic Hospitals, I am fully conscious of the many failures that have attended my earlier endeavours. The causes of these failures are in part general and in part individual.

From 1903–10, I was largely influenced by the Lorenz technique which was in vogue at that time. With the meagre instruction derived from observing Lorenz reduce one case in London, I embarked upon the treatment of a deformity which had previously baffled surgeons whatever method they had employed.

In 1903, orthopædic surgery was in a very different condition from that in which we find it to-day. The original British Orthopædic Association was defunct, and no new association had been formed. In America and on the Continent the opportunities for

Fig. 13.

the interchange of thought, methods, and results were well organized. I mention this, not to exonerate myself from blame, but because the results of treatment in these 49 cases do not fairly represent the results which are now being obtained, and by which the success or failure of manipulative replacement should be judged. Further, in my early cases no *x*-ray control was possible, for the reason that no *x*-ray installation was provided at the Orthopædic Hospital at that time.

From the experience thus gained, I am of opinion that no surgeon should attempt the treatment of a congenitally displaced hip unless he is in able to obtain *x*-ray proofs of his positions in plaster, and of the subsequent growth of the acetabulum and upper end of the femur, and unless he has had considerable opportunity of observing the methods and results of others. In this way only can the percentages of successes be increased.

Of the 49 cases, 45 were females and 4 were males. The left hip was dislocated 28 times, the right 9, and both 12 times—figures which show an unusually large number of left-sided cases. For the purposes of this paper I have endeavoured to re-examine all these cases within the last few months: the patients have been invited to attend the hospital and, if poverty has been pleaded, the railway fare has been offered as an inducement.

Eighteen cases, involving 23 joints, have failed to give me the opportunity of re-examination. I do not regard all these cases as failures. Some, no doubt, are; but others I observed for many years before the war, and showed radiograms of some of them at the British Medical Association meeting at Aberdeen in 1914, as cures. Of others again, I have had satisfactory reports from their medical attendants. But without recent *x*-ray confirmation they cannot be brought into any scientific classification, and I have therefore excluded from my list all cases that have not been recently examined.

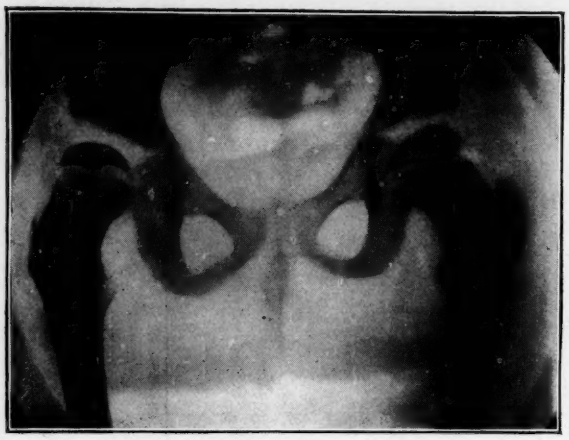


FIG. 14.

As an example showing how an error might otherwise creep in, *Fig.* 13 represents a left unilateral dislocation in a female, age $2\frac{1}{4}$, ten years after reduction: it shows that four-fifths of the head only is covered by the acetabulum, whereas *Fig.* 14, taken three years after reduction, shows the head completely surmounted by the acetabulum.

There remain for classification 31 cases, involving 38 joints. Classification so far has been simple; but further detailed classification of anatomical and functional results, as other observers have found, is difficult. The usual anatomical classification is divided into: (1) Anatomical cures; (2) Excentric reductions; (3) Anterior transpositions; (4) Relapses. Such may have served a useful purpose in the past, but is quite inadequate with our present knowledge. It came into being when surgical thought centred upon the dislocation as being the essential deformity, and the retention of the replaced head by the acetabulum as the highest ideal in the treatment. Such a classification is very one-sided and, though serving to describe the reaction of the acetabular elements to the stimulus of a replaced head, entirely ignores the reaction in the head and neck of the femur to the forces employed in reduction, and the stresses and strains of acetabular cohabitation.

CLASSIFICATION OF CASES.

| GROUPS | NO. OF CASES | PER-CENTAGE | AVERAGE AGE |
|---|---|---|---|
| 1. Concentric reduction with normal head and neck .. .. .. | 10 | 26·0 | 4·1 |
| 2. Concentric reduction with changes in the head and neck .. .. .. | 13 | 34·0 | 5·1 |
| 3. Excentric nearthrosis .. .. | 5 | 13·0 | 4·5 |
| 4. Anterior transpositions .. .. | 4 | 10·5 | 4·8 |
| 5. Posterior dislocations .. .. | 1 | 2·5 | 6·5 |
| 6. Loss of head and neck .. .. | 1 | 2·5 | 2·9 |
| 7. Unreduced dislocations .. .. | 4 | 10·5 | 6·75 |
| Total Cases .. | 38 | — | — |

In examining the radiograms of late results, I have been struck by the infrequency of anatomical cures as evidenced by them. By a strict definition, an anatomical cure is one which an *x*-ray examination shows is indistinguishable from a normal hip. To refer to two points only : a normal acetabulum shows a double contoured roof ; after reduction of a congenital dislocation, this double contour is of the rarest occurrence. I do not think I have seen it more than a few times. If we allow this variation, and such a change as the persistence of some mammilation of the roof to be within the normal, then the percentage of anatomical cures materially increases. Though we may reasonably include these and some other minor changes as being within the normal limits of anatomical variation, the grosser changes in the head and neck of the femur that occur in a large proportion of so-called anatomical cures would seem to demand a class of their own.

For this reason, I consider the above classification, which is employed for my cases, to be more satisfactory.

GROUP 1.—Of 38 joints recently examined, 10 only showed concentric reductions with normal heads and necks, whilst 13 showed concentric reduction with changes in the heads and necks, making 60 per cent of concentric reductions ; but only 26 per cent of anatomical cures.

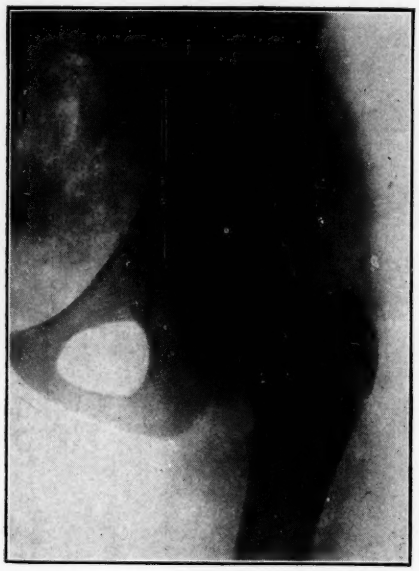


FIG. 15.

FIG. 16.

*Fig.* 15 represents a case of concentric reduction with normal head and neck. It is from a left unilateral case of a girl, reduced at the age of 4, *x*-rayed nine years after reduction. Function of the joint is complete.

*Fig.* 16 shows the opposite side for comparison.

*Fig.* 17 is a case of a girl with bilateral dislocation, reduced at the age of 4 years 8 months, and re-examined eight years after. The horizontal direction of the epiphyseal cartilage will be noted, and the entrance of the inner and lower angle of the neck into the acetabulum. It would appear that this horizontal direction of the epiphyseal cartilage has protected the head from displacement, and that the projecting angle of the neck has acted as a buttress preventing slipping of the head.

*Fig.* 18 shows a left unilateral dislocation in a female, reduced when $4\frac{1}{4}$ years old, and *x*-rayed nine years later, which shows a concentric reduction, with normal head and neck with a crescentic epiphyseal line.

FIG. 17.

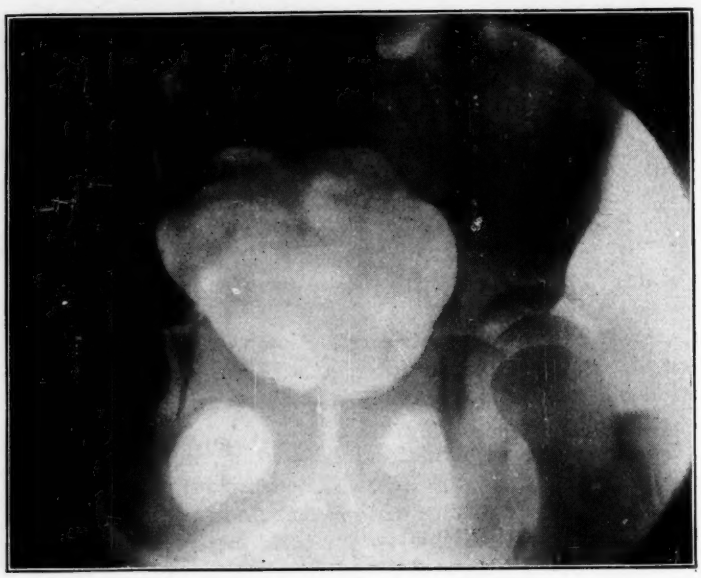


FIG. 18.

*Fig.* 19 is from a case of left unilateral dislocation in a female, age 7½, and shows the result twelve years later. The acetabulum is shallower than normal, but the

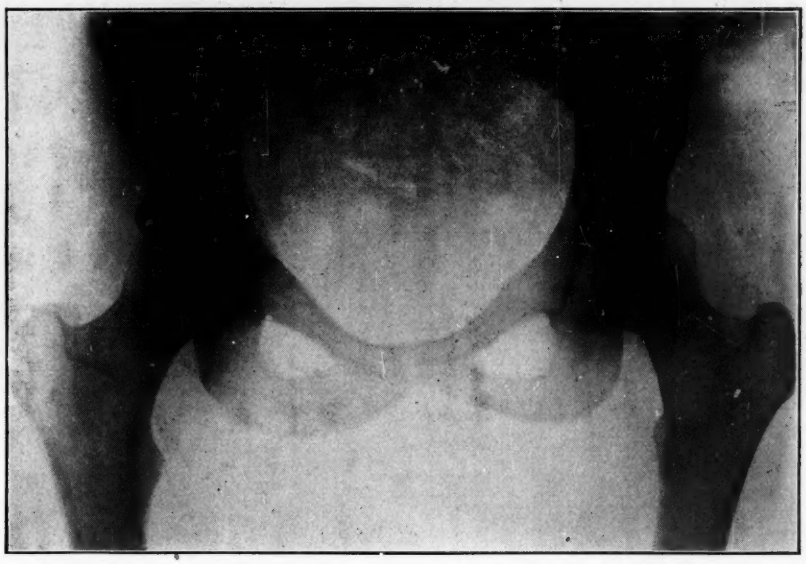


FIG. 19.

head and neck are well formed and the reduction is concentric. The functional result is excellent.

*Fig.* 20 represents the result five years after reduction of a left unilateral dislocation in a patient, age 3½ years. This case had been reduced and kept in plaster-of-Paris

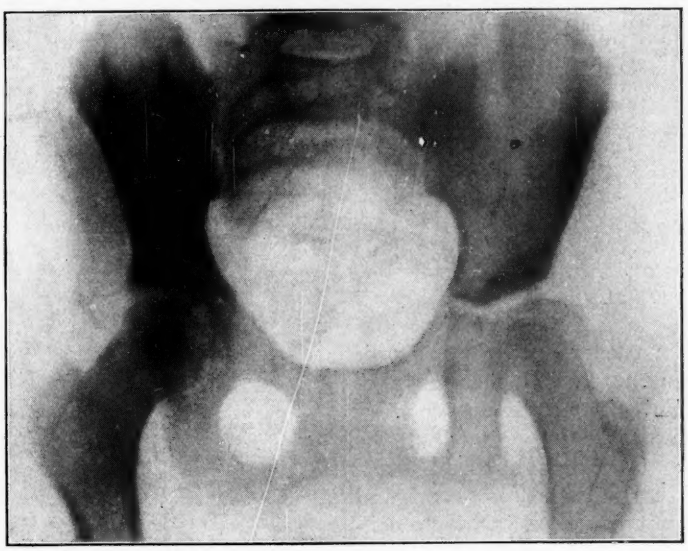


FIG. 20.

elsewhere; but retention failed. Fibrosis of the adductors necessitated their tenotomy before re-reduction could be obtained.

GROUP 2.—Turning to the concentric reductions with changes in the head and neck, a great variety of pathological lesions is found. The commonest is a diminution of the angle of inclination, and this is present in nearly all cases. Further changes are buffer-shaped heads, and flattening and spreading of the capital epiphysis over the neck; absorption of the neck; and, less frequently, an increase in the angle of declination.

*Fig.* 21 is from a bilateral case in a female, reduced at the age of 7 years 2 months. Radiogram taken six years later. The left side shows a concentric reduction with coxa vara, the right an excentric nearthrosis with varoid neck and atrophy of head and neck.

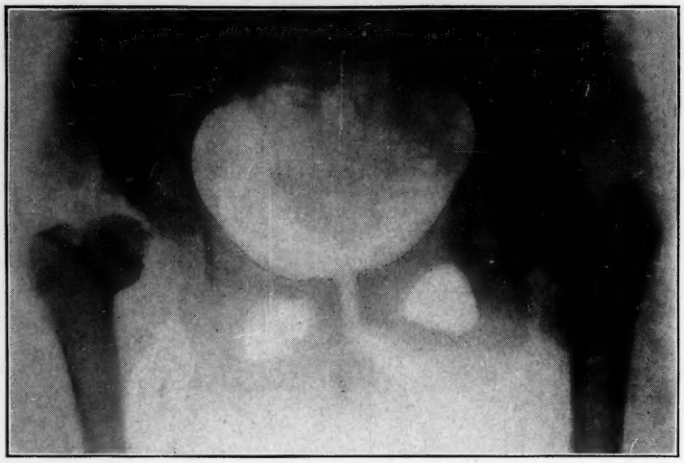


FIG. 21.

*Fig.* 22 shows a buffer-shaped head on a shortened neck, from a bilateral dislocation in a boy, reduced at the age of 6½, and *x*-rayed thirteen and a half years later.

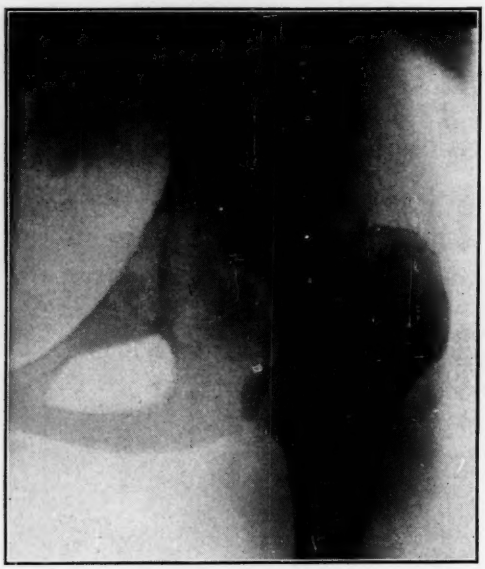


FIG. 22.

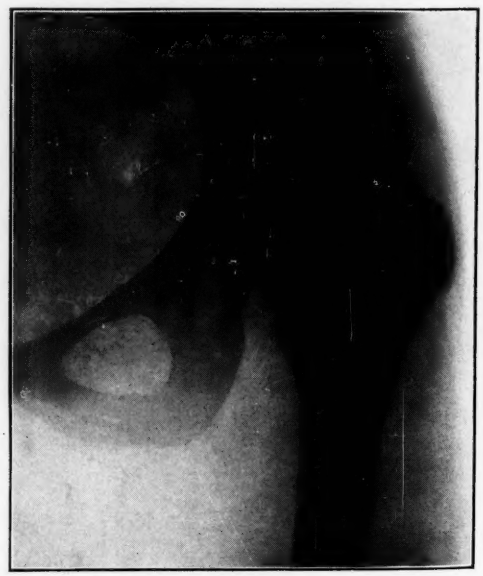


FIG. 23.

GROUP 3.—In the excentric nearthrosis cases are included those which show changes in the acetabulum. These changes consist of an absorption of the upper part of the acetabulum, so that the femoral head forms a new joint within the limits of the original acetabulum, but not concentric with its centre. Changes in the head and neck almost invariably accompany the changes in the acetabulum, and for the most part consist of a partial absorption of the head and neck. The changes are similar to those occurring in a dry arthritis, but there is no evidence to suggest that they are of tuberculous origin.

Thus, *Fig.* 23 represents a case of a female, age 5¾, left unilateral, *x*-rayed thirteen

years after reduction, which shows an excentric nearthrosis with well-shaped head directed at an angle of 130° to the shaft of the femur, with almost complete absorption of the neck. The upper end of the femur is bent laterally in the trochanteric region.

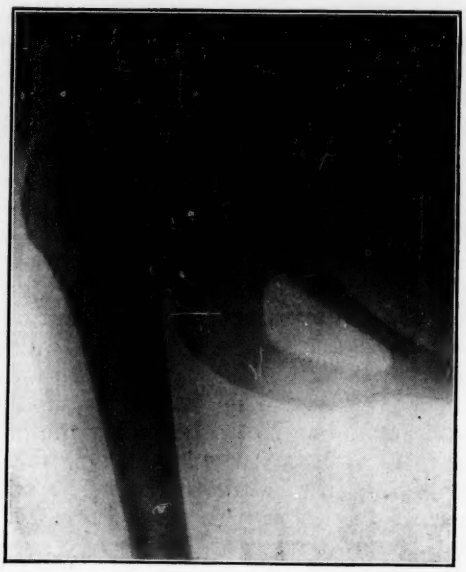


FIG. 24.

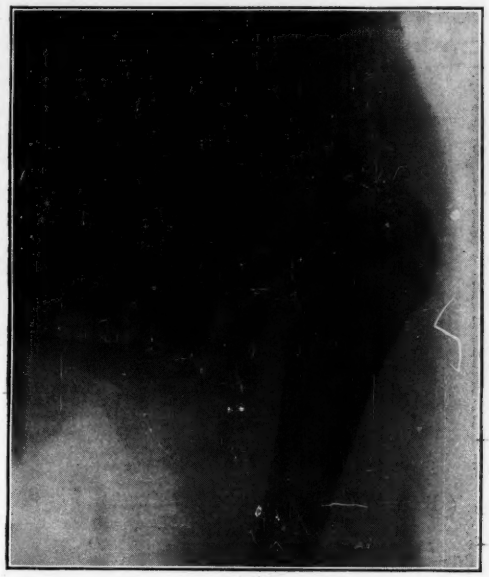


FIG. 25.

Compare with this *Fig.* 24, a bilateral case of a female, age 8½, *x*-rayed nine years after reduction. The right hip, here represented, was reduced easily ; the left gave much trouble. The right shows a coxa vara of severe degree and much shortening of the neck ; but the head is well formed. (? Place this in *Group* 2, i.e., concentric reductions with changes of head and neck.)

*Fig.* 25 is a left unilateral dislocation in a female, age 5, *x*-rayed ten years after reduction. It shows an excentric reduction with shortening of neck, without alteration of the angle of inclination, and with a well-formed rotund head. The neck is constricted about its centre.

FIG. 26.

*Fig.* 26 is from a left unilateral dislocation in a girl, age 4½, *x*-rayed eight years later. There was marked coxa valga when reduced. One year and a half later the hips were symmetrical. There was then interrupted observation. Now the radiogram shows an excentric nearthrosis with high valgus and the capital epiphysis displaced outwards.

GROUP 4.—With reference to anterior transpositions, I have noted few changes in the head and neck, which probably accounts for the extraordinarily good functional results.

GROUP 5.—Posterior redislocations conform in behaviour to the untreated cases, except that changes in the length and direction of the neck are common.

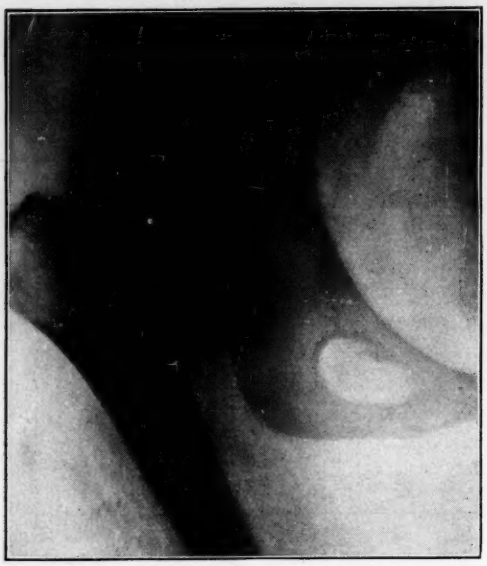


FIG. 27.

*Fig.* 27 is an example: bilateral dislocation, boy, reduced at 6½ years. Radiogram taken thirteen years later. The right femoral head is buffer-shaped, the neck much shortened and at an angle of 100°. Clinically, extension is short by 15°, but flexion is complete.

GROUP 6.—Complete loss of the head and neck is rare. I have one case only to record, a right unilateral, and a radiogram is given in *Fig.* 28. The patient was a boy age 2½, with multiple deformities. The illustration was taken sixteen years after reduction. Unfortunately I have no radiogram of the original condition. Notwithstanding the loss of the head and neck, the lateral apposition of the side of the femur to the pelvic wall affords a stable joint. He plays football, as he says, better than most, and is very much pleased with the result. Except that there is no scar I should have guessed that he had wandered to another's care and had his head and neck excised. *Fig.* 29, which represents his opposite hip, shows considerable contraction of the centre of the neck, with an expanded head.

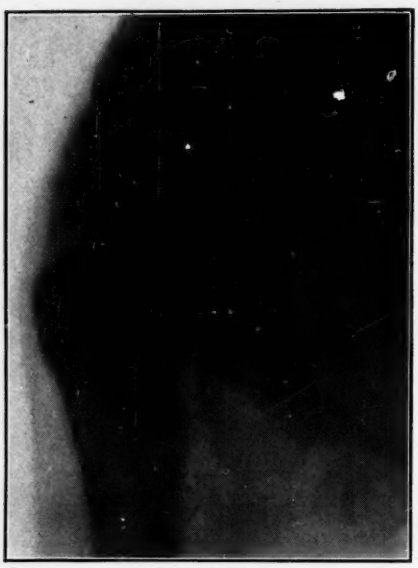


FIG. 28.

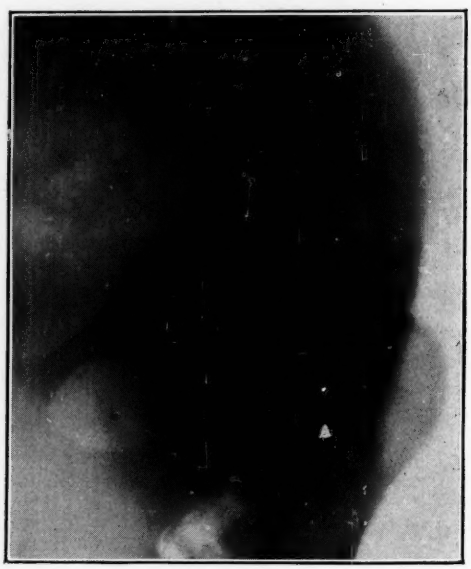


FIG. 29

*Fig.* 30 is from a girl, age 10½ years, in whom I fractured the neck, treating her by extension with a long Liston. The radiogram gives the appearance eleven years afterwards—a posterior dislocation, without obvious change in the angle of inclination. She is certainly no worse than she would have been if nothing had been done.

Of the functional results it is much more difficult to speak, because the personal element largely enters into the question.

No orthopædic surgeon can be successful unless he is an optimist; and it is very difficult to dissociate optimism from after-results. Further, it is essential that any classification that is to be intelligible to the ordinarily retentive memory should be short. Hence, for statistical purposes we are compelled to adopt such a classification as good, fair, or bad.

In general terms:—

1. Concentric reductions without any changes in head and neck are good. In fact, I think they are very good.

2. Concentric reductions with changes in head and neck vary; some are good, others fair. I have to record one bad result in this class—an ankylosis in external rotation and abduction with coxa vara of 90°.

3. Excentric reductions depend upon the degree of absorption. Three cases show good functional results and two fair. It is still too early to say whether progressive arthritic changes will not vitiate these early satisfactory results. I am not optimistic on this point.

4. Anterior transpositions give good functional results as a rule.

FIG. 30.

5. Posterior redislocations are indistinguishable from untreated cases.

I wish to record one case which showed every prospect of a concentric reduction with normal head and neck, which was attacked with anterior poliomyelitis of the same limb, and an excentric nearthrosis resulted.

My method of reduction was founded upon Lorenz's technique: gradually forces were diminished and muscles spared, so that my later cases were reduced by a much more gentle and less disruptive process than the earlier ones. Except in very few cases where I have used internal rotation after Lange's method of retention, I have employed a short spica reaching from the waist to above the knee. Early locomotion on a high patten has been adopted. In bilateral cases the period of retention in plaster has been shortened as much as possible—from three to six months. In unilateral cases I have kept up retention for much longer than is usually accepted—eighteen months to two years. With few exceptions retention has been maintained in 90° flexion, 70° abduction, and an indifferent rotation. Werndorff's axillary abduction has promoted successful retention in difficult cases where the acetabular roof has been markedly deficient.

After removal of the plaster, abduction in walking has been secured by applying a 1½-in. patten to the sound side.

I have attached great importance to a plaster bed made according to the formula 90, 70, 0, up to the end of the third year after successful retention. In unilateral cases one hip only has been enclosed in the plaster. Exceptional cases have been treated with modifications according to the structure and stability of the joint; but, in general, the above may be taken as routine.

I have fractured some necks, but no femoral shafts: I have had no nervous or arteriovenous complications. There has been one tragedy—the death of a patient, age 8½, after reduction, from double pneumonia, without a post-mortem examination.

# LATE RESULTS OF TREATMENT OF CONGENITAL DISLOCATIONS OF THE HIP.

By H. A. T. FAIRBANK, D.S.O., O.B.E.

In opening the discussion on "The Late Results of the Treatment of Congenital Dislocation of the Hip" at the meeting of the British Orthopædic Association at Liverpool in December last, I reported the results of my personal experience with cases treated before the war. The subject seems to be of sufficient importance to warrant the publication of a more detailed paper than it was possible to present before the above meeting. If any excuse were needed it might be found in the fact that even at the present time there are surgeons who have still to be convinced that the affection is curable, while the numbers of cases left untreated till an age has been reached when completely successful treatment is impossible are far too large. I do not propose to discuss the reports published in medical literature, as I think the space at my disposal will be fully occupied in dealing with the results of my personal experience, small though it is.*

The Committee of the Association decided that the discussion should be limited to results noted after a lapse of at least five years from the date of operation. In presenting thise rport I propose to refer to some of the complications met with during treatment, and to consider the influence, if any, exerted by these complications upon the results. The cases investigated include all those treated by me, at Ormond Street and elsewhere, before the war, that is, during the years 1903 to 1914 inclusive. The number of cases amounts to 146, with a total of 175 hips. Every effort has been made to be honest in this investigation : with the same object in view all disasters met with in this series are recorded.

**Method of Treatment.**—The method of treatment adopted has been the Lorenz manipulative reduction as a rule, though in some difficult cases every conceivable manœuvre has been tried. Only in the early cases was the Lorenz method followed strictly ; before long the amount of violence used was reduced considerably ; unnecessary damage to the skin over the adductors was particularly avoided. Muscles were ruptured only when stretching was insufficient. The skin was sterilized as for an open operation. In every case the manipulations after the reduction had been accomplished, suggested by Lorenz, with a view to getting the head well home in the acetabulum, were carried out : these I believe to be a very important part of the operation. A small sandbag, except in the earlier cases, was used as a fulcrum behind the head of the femur in place of the Lorenz wedge. The hamstrings were usually left alone till later ; they were gradually stretched while the leg was in plaster. The Lorenz position was chosen for fixation in plaster, the leg being retained in this right-angle position for never less than six months. Cases with particularly poor stability were fixed in the 'axillary position' for a few months and then brought to a right angle. A change of position during treatment in plaster—for instance, internal rotation—was only adopted when the head of the femur showed a tendency to ride forwards. Patients were encouraged to walk after the first month in plaster, while active and passive extension of the knee was also encouraged. The knee was not included in the plaster as a routine. In the younger children the plaster was removed at the end of six months and nothing further done. In the older children—particularly in bilateral cases—the plaster cast would be re-applied once or more often with diminished abduction ; while later, massage, exercises, and passive stretching by hand and weight in the direction of hyperextension, would be carried out for some months.

---

* It was originally intended that this report should include all the cases treated at the Hospital for Sick Children, Great Ormond Street, up to 1916. In spite of the courtesy and generous assistance of my colleagues, I have been able to do so little in the way of investigating the present condition of their cases that I am not yet in a position to offer any report on them.

Thirteen cases were treated by open operation during the period under consideration. The results of these operations are not included in the tables of results given below, though most of the cases are recorded in those tables as failures after manipulative reduction or attempted reduction. The open operations will be dealt with separately.

**Anatomical Results.**—As a result of consultation with some of the other members of the Association, the cases have been divided into three age groups, namely: (1) Under three years; (2) Three to six years; (3) Six years and over. Only 7 cases were above nine years of age. The oldest was fifteen. No case has been omitted.

*Table I* shows the total number of hips dealt with, and the results recorded in all those cases in which treatment was completed. This list gives some details not included in the next table, and assists in explaining how the latter was compiled.

*Table I.*—Results in Total Number of Hips Treated by Manipulative Reduction, or Attempted Reduction, up to the Year 1914.

*Unstable (Open Operation):* Hips in which stability after reduction was so poor, and prognosis so bad, that open operation was deemed advisable. *Sepsis:* Suppuration in the hæmatoma of the adductors. *Lost sight of:* Those known to have died from intercurrent disease before final removal of plaster cast, and those who ceased to attend before the treatment was complete and in which the result is unknown.

| Age | Failed to Reduce | Unstable (Open Operation) | Sepsis | Lost Sight of | Femur Fractured | Cures | Anterior Reposition | Relapses | Totals |
|---|---|---|---|---|---|---|---|---|---|
| **Unilateral:—** | | | | | | | | | |
| Under 3 | — | — | 1 | 4 | — | 26 | 3 | 2 | 36 |
| 3, 4, and 5 | 1 | 1* | 1 | 5 | 1 | 26 | 6 | 3 | 44 |
| 6 and over | 4 + 1* | 1* | — | 3 | 2 | 9 | 8 | — | 28 |
| **Bilateral:—** | | | | | | | | | |
| Under 3 | — | — | — | — | — | 8 | 5 | 2 + 1* | 16 |
| 3, 4, and 5 | 4* | — | — | 1 | 2 | 14 | 7 | 5 + 2* | 35 |
| 6 and over | — | 1* | — | 1 | — | 4 | 4 | 4 | 14 |
| Totals | 10 | 3 | 2 | 14 | 5 | 87 | 33 | 19 | 173 |

* Open operation. Two other cases were treated by open operation after 'Lorenz' by other surgeons.

*Table II.*—Late Results of Manipulative Reduction.

The hips in columns of *Cures* and *Anterior Repositions* were traced for at least five years after reduction. The *Failures* include every hip treated in which the result was known to be a failure. The figures are derived from columns *Failed to Reduce*, *Unstable (Open Operation)*, *Sepsis*, *Femur Fractured*, and *Relapses* in *Table I.*

| Age | Class 1 Cure | Class 2 Cure | Anterior Reposition 1 | Anterior Reposition 2 | Failures from all Causes | Totals |
|---|---|---|---|---|---|---|
| **Unilateral:—** | | | | | | |
| Under 3 | 10 | 4 | 3 | — | 3 | 20 |
| 3, 4, and 5 | 8 | 1 | 2 | 4 | 7 | 22 |
| 6 and over | 1 | 5 | 2 | 5 | 8 | 21 |
| Totals | 19 | 10 | 7 | 9 | 18 | 63 |
| **Bilateral:—** | | | | | | |
| Under 3 | 6 | 1 | 4 | 1 | 3 | 15 |
| 3, 4, and 5 | 5 | — | 1 | 3 | 13 | 22 |
| 6 and over | — | 4 | 1 | 2 | 5 | 12 |
| Totals | 11 | 5 | 6 | 6 | 21 | 49 |

In *Table II* are included only those cases—comprising 112 hips in all—in which the result is known after a lapse of at least five years from the date of reduction. All the known failures shown in *Table I*, from whatever cause arising, are included in this table, e.g., failure to reduce, fracture of the femur, relapse, etc.

The vast majority of those reported as cures or 'anterior repositions' have been followed up for a much longer period than five years, as may be seen by a glance at *Table III*. All cases classed as 'cures' have been proved by *x* rays, with the

*Table III.*—Length of Time from Reduction to Date of Final Examination and Report.

| Years after reduction | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of hips .. | 3 | 6 | 8 | 12 | 4 | 7 | 4 | 15 | 2 | 9 | 2 | 1 |

More than half were seen over 10 years after reduction; more than three-quarters over 8 years.

exception of one. This case was known to be a cure at first and was examined by me more than twelve years after reduction, and I am quite sure that the hip was perfect in every way, anatomically and functionally; the legs were equal in length: no complaint of any kind could be elicited; repeated attempts at obtaining a skiagram have so far failed. Among the 'anterior repositions' are included 6 which were known to be

FIG. 31.—*Case* 1. Congenital dislocation of left hip in a girl, age 1 year 10 months. The radiogram taken 10 years after reduction, showing a *Class* 1 Cure. Function perfect.

'anterior repositions' and not cures before the five-year limit was reached; but of these radiograms could not be obtained at a later date, although their present functional result can be reported. The results other than failures have been classified as 'anatomical cures' and 'anterior repositions', each class being again subdivided. The radiograms will indicate better than words the type of case in each class. I suggest that this classification might be worthy of general adoption, as I submit that it is sufficiently elaborate without being too complicated. In the *Class* 1 Cures are included those cases where

the head of the femur is in the acetabulum and approaches the normal in size and shape (*Figs.* 31, 32, 33, 34, etc.). Among the *Class* 2 Cures are placed those which show an equally definite anatomical cure, but in which the head of the femur is distinctly abnormal, either in the direction of being mushroomed (*Fig.* 35), varoid (*Fig.* 36), or of being partly or completely worn away by what I prefer to call 'absorptive arthritis' (*Fig.* 37, etc.). By 'anterior reposition 1', I mean a case with a fairly well-formed rounded head opposite the upper lip of the acetabulum, with or without the formation of a socket at this point (*Figs.* 38, 39, 40). In 'anterior reposition 2' of this group are placed the cases with gross changes in the bones, which usually take the form of flattening and absorption of the head of the femur, and flattening and condensation of the bone at the site of the upper lip of the acetabulum (*Fig.* 41). No doubt some surgeons would classify separately the hips showing such deformities as coxa vara, marked anteversion of the neck of the femur, poorly-developed acetabulum, etc., in the late skiagram; but in any attempt to standardize the estimation of late results, over-elaboration seems inadvisable.

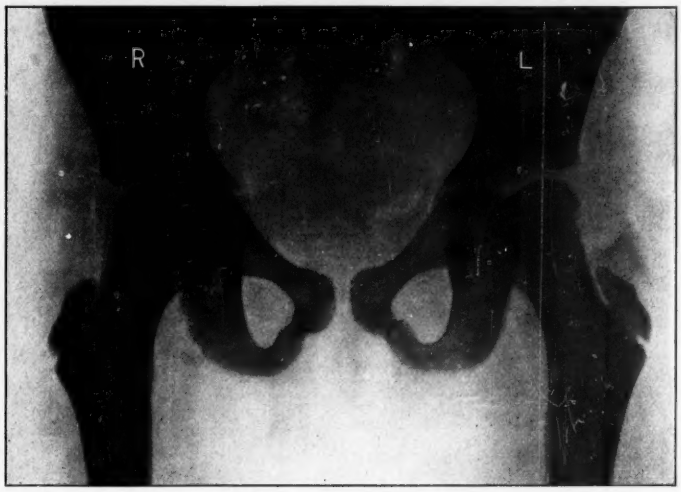



FIG. 32.—*Case* 2. Boy, age 2 years at operation; bilateral congenital dislocation; radiogram taken 9 years after reduction, showing *Class* 1 Cure both sides. Coxa valga is present on both sides, but function is perfect.

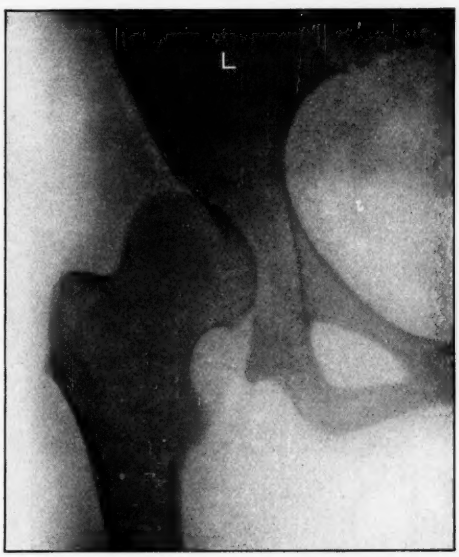



FIG. 33.—*Case* 3. Congenital dislocation of the left hip in a girl, age 4 years at time of operation. Left hip 11 years after, showing result sufficiently normal to be called *Class* 1 Cure, i.e., lowest limit of first-class cures. The acetabulum is still poorly developed and head of femur is imperfectly covered by upper lip of acetabulum. Function perfect.

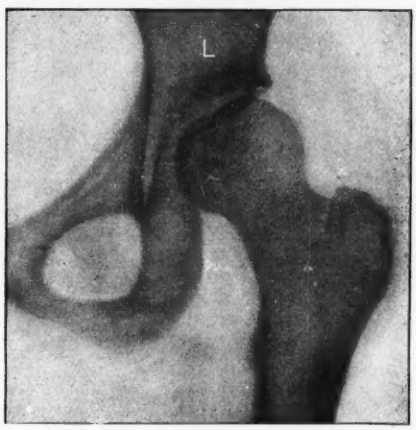



FIG. 34.—*Case* 11. Congenital dislocation of left hip 13 years after reduction, showing *Class* 1 Cure. Function perfect.

*Table IV* shows the percentage results at the various ages of the unilateral and bilateral cases. These are worked out from the figures given in *Table II*; they can therefore I

think, be taken as on the low side, since all the known failures and disasters are included, whereas only those partial or complete successes which have been examined after a lapse

FIG. 35.—*Case* 4. Congenital dislocation of left hip in a girl age 1 year 10 months. The radiogram is taken nearly 15 years after reduction, showing *Class* 2 Cure. Head of femur is mushroomed. Radiographic changes suggestive of pseudo-coxalgia were seen during treatment. A radiogram taken before operation showed total absence of ossific centre for dislocated head of femur, this centre being present on the normal side. Function perfect.

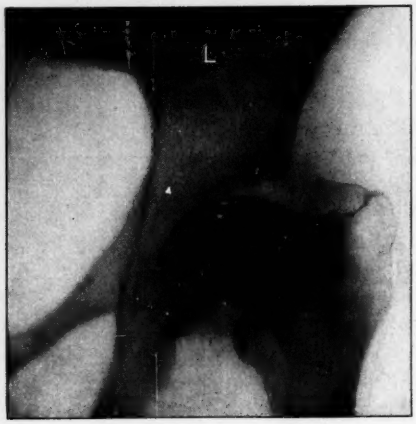



FIG. 36.—*Case* 12. Boy, age 6½ years, congenital dislocation of left hip, with some coxa vara. Radiogram taken 10½ years after reduction showing *Class* 2 Cure. Marked coxa vara. Function perfect

of five years are included. It will be noticed how, in the unilateral cases, the percentage of cures falls rapidly as we pass from the younger to the older children, while the per-

FIG. 37.—*Case* 5. Girl, with dislocation of the left hip, age 10½ years at time of operation. The hip, 11 years after reduction, showing *Class* 2 Cure. Gross changes are seen in head and neck of femur, a result of absorptive arthritis. Function is good but not perfect.

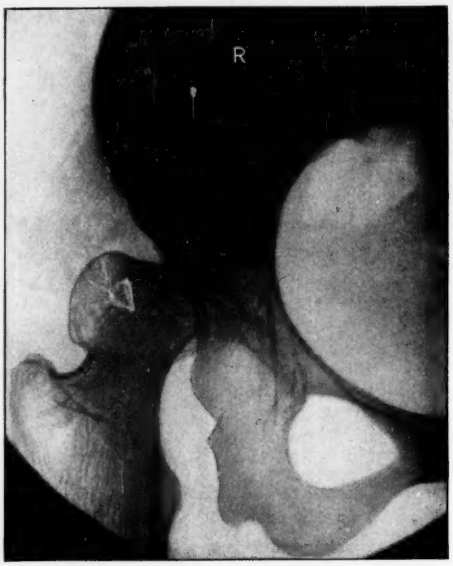



FIG. 38.—*Case* 6. Girl, age 6½ at operation. Congenital dislocation of right hip 13 years after reduction. Result: 'anterior reposition', *Class* 1. Head of femur fairly rounded. Function fair.

centage of 'anterior repositions' increases. In the bilateral cases the figures are somewhat surprising, though again showing the advantage of early operation. I think the reason

for the cases of six years and over showing a better percentage result than those in the middle age-group lies in the fact that the former were subjected to a more careful selection,

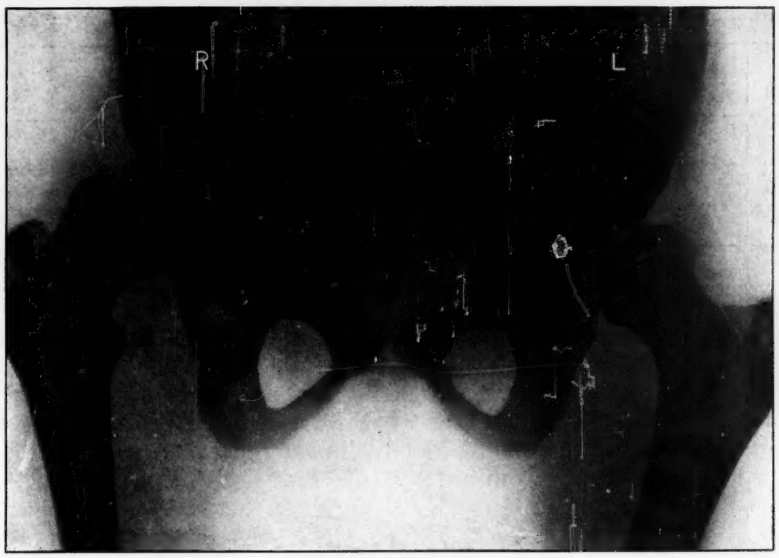



FIG. 39.—*Case* 7. Girl, age 1 year 11 months, with bilateral congenital dislocation. Radiogram taken 10 years after reduction of both hips. Result: 'anterior reposition', *Class* 1, on both sides. The right hip is more displaced than the left, but opposite the upper lip of the acetabulum. Function fair.

while in the latter reduction was attempted in almost every case seen. At any rate, these tables serve to prove yet again the enormous advantage a young child has over one

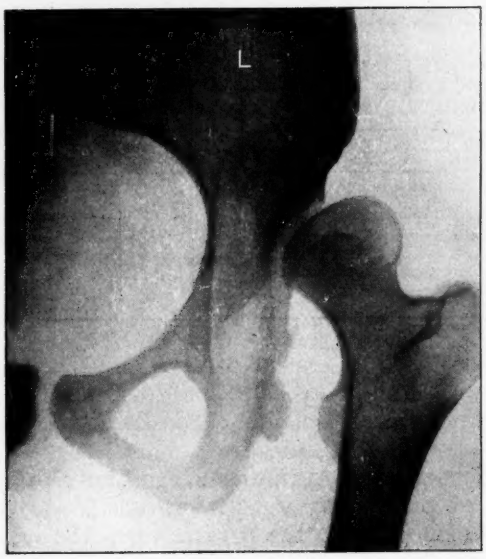



FIG. 40.—*Case* 15. Left hip 11½ years after reduction, showing 'anterior reposition', *Class* 1. This hip was not treated by open operation. Function fair. Compare with *Fig.* 50—right hip of same case.

FIG. 41.—*Case* 8. Girl; congenital dislocation of left hip, age 8 years at operation. Radiogram taken 13½ years after reduction of the dislocation. Result: 'anterior reposition', *Class* 2. Gross changes in the head and neck of the femur, with flattening and condensation of bone in the region of the upper acetabular margin, the result of absorptive arthritis. Function good.

whose treatment has been unwisely delayed. It is generally agreed that bilateral cases are more difficult and troublesome in every way than the unilateral, and no one expects as good results in the former as in the latter.

*Table IV.*—Percentage Results at Various Ages Compiled from Table II. (Five Years and Upwards after Reduction.)

| Unilateral | | | Bilateral | | |
|---|---|---|---|---|---|
| Age | Cures per cent | Anterior Repositions per cent | Age | Cures per cent | Anterior Repositions per cent |
| Under 3 years | 70 | 15 | Under 3 years | 46·6 | 33·3 |
| 3, 4, and 5 | 40·9 | 27·2 | 3, 4, and 5 | 22·7 | 18 |
| 6 and over | 28·5 | 33·3 | 6 and over | 33·3 | 25 |
| All ages | 46 | 25·3 | All ages | 32·6 | 24·4 |

**Function.**—Yet another table (*Table V*) is presented, showing the functional results arranged under the headings 'good', 'fair', and 'bad'. The vast majority of 'good' are absolutely perfect: that is to say, the walk is excellent, and no complaint whatever is made; included are a few who limp if very tired or who tire a trifle sooner than they should, although at other times no fault can be found with the function of the joint. No attempt is made to define exactly what is meant by 'fair' and 'bad', since the personal element cannot be excluded from any such rough classification. It will be seen that these small figures suggest that the functional result in most cases agrees with the anatomical result.

*Table V.*—Functional Results of Cases Included in Table II. (Five Years and Upwards after Reduction.)

| Age | Class 1 Cure | | | | Class 2 Cure | | | | Anterior Reposition I | | | | Anterior Reposition II | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | G. | F. | B. | Total | G. | F. | B. | Total | G. | F. | B. | Total | G. | F. | B. |
| **Unilateral:—** | | | | | | | | | | | | | | | | |
| Under 3 years | 10 | 10 | — | — | 4 | 3 | — | 1 | 3 | 1 | 1 | 1 | 0 | — | — | — |
| 3, 4, and 5 | 8 | 7 | — | 1 | 1 | 1 | — | — | 3 | 1 | 2 | — | 2 | — | 1 | 1 |
| 6 and over | 1 | 1 | — | — | 5 | 4 | 1 | — | 2 | 1 | 1 | — | 5 | 3 | 1 | 1 |
| **Bilateral:—** | | | | | | | | | | | | | | | | |
| Under 3 years | 6 | 5 | — | 1 | 1 | — | — | 1 | 4 | — | 2 | 2 | 1 | — | 1 | — |
| 3, 4, and 5 | 5 | 5 | — | — | 0 | — | — | — | 2 | — | 1 | 1 | 3 | — | 1 | 2 |
| 6 and over | 2 | 2 | — | — | 2 | 1 | — | 1 | 1 | 1 | — | — | 2 | — | — | 2 |

G. = good. F. = fair. B. = bad.

The *Class* 2 Cures are not associated with such good function as the *Class* 1, while the 'anterior repositions' give even worse results. It is only occasionally, in my experience, that the anatomical and functional results markedly disagree.

It is about the later histories of the imperfect anatomical cures, such as I have put in *Class* 2, and of the 'anterior repositions' that we particularly want information. Are we justified in thinking that we have done permanent good to the patient when the result can only be placed in one of these latter classes? Although in many we have undoubtedly improved the function greatly, do we really delay the onset of pain and increasing disability, i.e., arthritis, which I think we rightly regard as the inevitable fate of the untreated case? This is one of the points on which more information is so urgently needed. Time alone can solve the problem, but I think we have to admit that in some cases reduction—even successful reduction—has been followed by changes in the joint which the operation was intended to prevent. This knowledge should influence us, I think, very strongly

when we attempt to raise the age limit for reduction. My own feeling is that results do not warrant attempts at reduction being made after nine years of age in a unilateral case, and six years in a bilateral. Of 8 cases treated when over nine years of age, only one shows a cure, and that is a *Class* 2. In 4, attempts at reduction failed, while in one of these a greenstick fracture of the femoral neck was produced.

It is interesting to note that in four unilateral cases with a *Class* 1 Cure, the affected leg is now the longer of the two, the difference varying from a quarter to half an inch. These four were all operated upon before the age of three: the final examinations were made eight to ten years after reduction. In the *Class* 2 Cures there is one, aged two years at operation and examined twelve years later, with half an inch of lengthening; in this case the function is bad, owing to arthritic changes in the joint, while the 4 cases in *Class* 1 have excellent functional results. The lengthening seems to involve the tibia and fibula as well as the femur. In one 'anterior reposition', a girl 6½ years at the time of reduction and now aged 19, there is a quarter of an inch of lengthening: the tibia on the affected side is half an inch longer than that of the normal leg. In some other cases with imperfect results the changes in the head and neck of the femur suggest the presence of a greater amount of shortening than is actually found by the usual method of measurement. In only two of the unilateral cases with a *Class* 1 result is there any shortening of the affected limb.

It is noteworthy that only a quarter of the 'anterior repositions' are credited with good functional results: in a quarter the function was 'bad', while in the remaining half it was 'fair'. At least a quarter complain of pain in the hip, and more than half the cases limp. Shortening amounts to about one inch in the cases seen from 6 to 14 years after operation. Two, age 8 and 9 years respectively at the time of operation, showed as much as 2 inches of shortening 13 and 11 years later. Lordosis was absent in some, present in many, and varied from a slight to a severe degree. Lordosis should, I think, have been avoided in a greater number of cases, if the after-treatment had been more efficiently carried out. Trendelenburg's sign was present in 11 cases, absent in 9, indefinite in 3, while it was not noted in the remaining 4. Those with a positive Trendelenburg had on the average a worse functional result than those without this sign. These details are given for what they are worth, because there seems to me to be some grounds for thinking that the general opinion on 'anterior repositions' inclines towards optimism.

**Age.**—Some surgeons seem to be against reduction before the age of two years. Theoretically the earlier the reduction is made the more likely is an anatomically normal joint to result. The writer is inclined to operate as early as 18 months in the absence of any indication for delay. In this series, 9 cases were operated upon between the ages of 1½ and 2 years. The results show 7 cures, 5 in *Class* 1 and 2 in *Class* 2; and 2 'anterior repositions', one in each class. Better results than these are not likely to be obtained by delaying the operation. The results obtained when reduction has been delayed till after the ninth year are in marked contrast to the above, and have been referred to already.

**Sex.**—As regards any possible influence of sex on the result, it is only necessary to say that reduction was not, on the average, more difficult, while the results were rather better, in boys than in girls.

**Early Prognosis and Late Results.**—By testing the stability of the reduced hips at the time of operation, and comparing the prognosis thus determined with the late results, it has been found that such prognosis can be made with fair accuracy, especially in the younger children.

## COMPLICATIONS.

We now pass to the consideration of some of the complications of treatment.

[*Note.*—Wherever figures are given below, these invariably refer to the number of instances of a particular complication met with in the 112 hips dealt with in this report, and not in the total hips treated up to 1914.]

**Complications of the Operation itself.**—Fractures of the femur occurred on five occasions. This figure gives a misleading impression as to the frequency of this accident:

five is the total number of fractures met with in the writer's experience, i.e., in just over 200 operations. No fracture has occurred in the last 97 attempted reductions. In each case of fracture all attempts at treatment of the dislocation were abandoned. So far as is known no permanent harm resulted from this accident.

The only instance of injury to a nerve was one in which the sciatic was bruised in a prolonged and unsuccessful attempt to reduce a dislocated hip in a girl, age 14, the Lorenz wedge being used. Fortunately the nerve recovered completely. A sandbag has been used instead of the wedge ever since, while attempt at reduction at such an age has not been repeated.

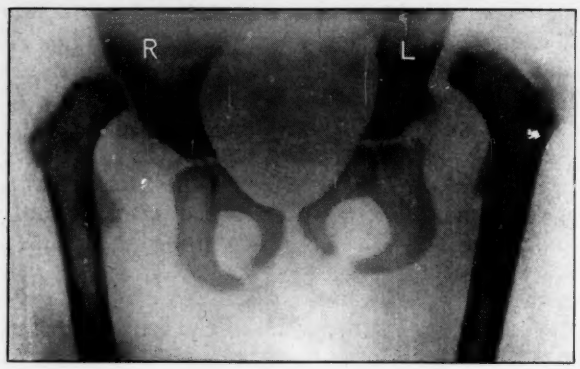



FIG. 42.—*Case* 10. Boy, age 2 years. Bilateral dislocation, before operation.

Suppuration of the hæmatoma caused by damage to muscles occurred twice. The details of the first case were reported in 1908.* Treatment by another surgeon had been followed by relapse, and, probably as a result of the former operation, reduction was extremely difficult for the age (3½ years). Infection of the hæmatoma occurred, and in spite of radical surgical treatment it ended fatally. The second case is recorded below. It is advisable to be cautious in dealing with cases that have relapsed after previous efforts at cure, while care should be taken to see that a child is in good general condition and free from any source of infection before attempting reduction. Unnecessary injury to muscles is to be avoided, not only because of the risk of possible infection, but because the ultimate functional result may be affected thereby.

**Pseudo-coxalgia** (osteochondritis deformans juvenilis).—Changes in the head of the femur similar to those seen in this affection, though absent before operation, were noted after reduction in 7 cases. The fluffy, broken-up appearance of the capital nucleus was more obvious than the flattening typical of coxa plana. One case had bilateral dislocations, but changes in the head of the femur were found on one side only (*Case* 10, *Figs.* 42–45). Another similar bilateral case with pseudo-coxalgia in one hip only has been met with, but as it could not be followed for so long as five years it is not included with the seven. In only one of the seven, the bilateral case, had any special difficulty, involving excessive trauma, been met with during reduction. Their ages ranged from 20 months up to 7 years at the time of operation. The changes in the head of the femur were noticed

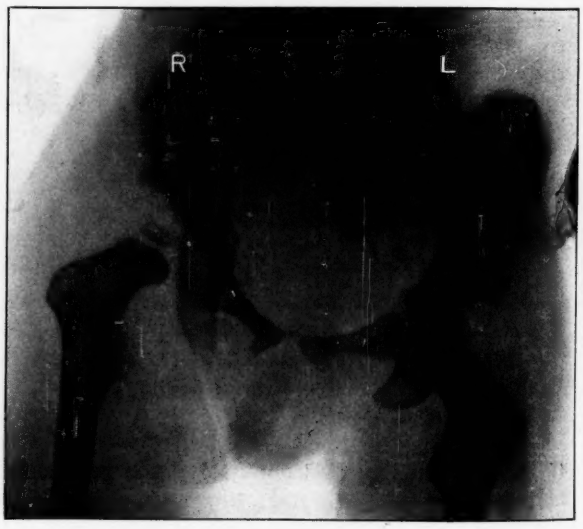



FIG. 43.—The same case as *Fig.* 42, one year after reduction, showing slight changes in the head of the right femur. Note the upper lips of the acetabula.

* *Lancet*, 1908, ii, 1752.

as a rule about twelve months after reduction, but this must not be taken as an indication of the exact time of onset of the affection. Hospital cases were *x*-rayed a few days after reduction, and if all went well the examination was not repeated until the affected limb had come down parallel to its fellow or nearly so. The late results of these seven cases show 6 cures (4 with good function, 1 with fair, 1 with bad) and 1 'anterior reposition' (function fair). In all but one, be it noted, the late radiogram shows a flat and spread-out or mushroomed head, placing them in the second classes of the two groups. It would seem therefore that this affection, whatever its true nature, does not lead to relapse of the dislocation, but does mar the result to some extent.

FIG. 44.—The same case as *Fig.* 42, but 3 years after reduction, showing typical fragmentation (pseudo-coxalgia) of the right hip. No changes on the left side.

**Arthritis.**—Stiffness of the hip, suggesting subacute or chronic arthritis, coming on in the course of treatment was experienced six times. The stiffness was first noticed from 7 to 15 months after reduction, and lasted for periods varying from a few weeks to 18 months. The exact date of onset of those

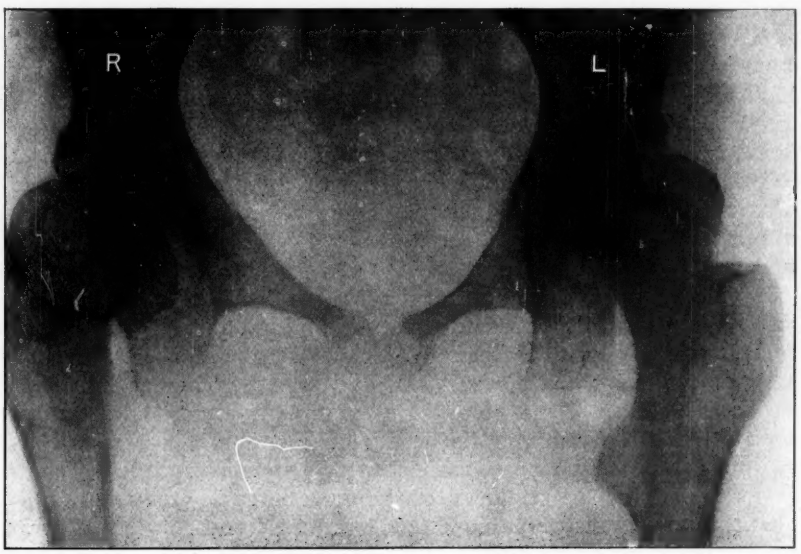



FIG. 45.—The same case as *Fig.* 42 12 years after reduction. Results: Right, *Class* 2 Cure, with mushroomed head. Left, *Class* 1 Cure. Gait perfect, but walks very little on account of pain.

discovered soon after removal of the plaster is necessarily doubtful. It occurred in children of all ages ($2\frac{1}{2}$ to 9 years). In one case, a girl age 9, it followed a fall ten months after reduction; in another, changes resembling pseudo-coxalgia were seen in the skiagrams. The duration of symptoms varied from a few weeks to 18 months, but in

every case the stiffness gradually subsided with rest, very often imperfect rest. The number of cases is too small for definite conclusions to be drawn, but it would seem that the results are spoiled to some extent. These cases showed only one *Class* 1 Cure, three *Class* 2, and two 'anterior repositions', one in each class. Only 3 showed good functional results. This arthritis is quite distinct from 'absorptive arthritis' already referred to: as a rule the former is not followed by the changes in the joint which are characteristic of the latter.

**Anterior Displacement.**—Displacement forwards of the head of the femur during treatment is, of course, not a very rare complication. This usually takes place while the child is in the plaster case, but may occur later. The head of the femur was found riding forwards on the horizontal ramus of the pubis in five cases. In the majority of these the head was easily restored to its normal position by bringing the knee a little forward and rotating in the femur and re-applying the plaster. In only two was any difficulty experienced in correcting the displacement: both these and one of the others resulted in 'anterior repositions', while the remaining two were 'cures'. If left uncorrected this complication will certainly diminish the chances of a 'cure'; but if looked for, and corrected without delay when found, it has only a small effect on the results. The above figure (5 cases) does not give a correct idea of the frequency of this complication, for 17 cases (19 hips in all) were met with in the total pre-war series. By chance only five of these could be traced for 5 years and upwards; but the rest, as far as is known, give results similar to those recorded above.

**Ankylosis.**—I have met with one case of ankylosis after the so-called 'bloodless' reduction in this series. In this, a unilateral case of 2 years with easy reduction, the hæmatoma of the adductors suppurated, pyæmia followed, both hips became secondarily infected, and both ankylosed. One hip in a girl of 6 years treated by open operation gradually became fixed, though aseptic throughout. Trans-trochanteric osteotomy was performed to get the limb into better position: three months later (2½ years after reduction) a definite though small amount of movement was present in the hip-joint. Unfortunately the final result in this case is unknown.

**Vulnerability to Infection.**—Have we any evidence that a congenital dislocation, reduced or unreduced, is more liable to infections than a normal hip? We have the cases of arthritis following reduction, but these may well be traumatic in origin rather than infective. In the first of the two cases just mentioned the infection attacked the normal as well as the affected hip, in addition to various other portions of the body. Open operation is, I feel sure, more likely to be followed by an apparently aseptic arthritis leading to ankylosis than is manipulative reduction. I have one or two cases that seem worthy of brief mention here.

A girl had her right hip reduced at the age of 2½ years. The hip, 4½ years later, was 'in' and perfect in every way, the leg being slightly the longer of the two. This happy condition was said to have continued for another 7 years, i.e., 11 years in all, when the girl suddenly got pain in the leg after an attack of appendicitis. A diagnosis of tuberculous disease was made by another surgeon, and a single Thomas hip splint was worn for eighteen months. When seen 3 years later the hip was almost fixed, and was painless. *X* rays showed a curious condition, the head of the femur being divided into two and covering the upper part of the neck, which latter projects inwards below to articulate with a socket at the site of the upper lip of the acetabulum. One can only classify it as an 'anterior reposition'. It is probable that this hip was never a perfect 'cure' and very gradually passed into the condition of 'anterior reposition', and that some low-grade infection of this subluxated joint took place. The only early radiogram available, taken 13 months after reduction, when re-examined in the light of a wider experience, suggests that the joint was not quite so stable as we then thought it to be. The infection was certainly non-tuberculous.

A bilateral case, age 2 years, cured on both sides, had an attack of subacute rheumatism with cardiac lesion in 1918, i.e., about 9 years after reduction. All affected joints cleared up except the hips, which continue to give him so much pain that he

hardly walks at all. Yet his gait is extremely good, and *x* rays show the hips to be *Class* 1 and *Class* 2 Cures respectively (*Case* 10). If pseudo-coxalgia is inflammatory in origin, as Dr. Calvé has, I think, proved, the cases with this complication cited above must be considered as instances of infection attacking the hip after reduction.

Lastly, there is the painful condition of the hip-joint, with increasing flexion and tendency to adduction, which, it is generally admitted, sooner or later affects all cases in which the dislocation has not been treated. The pain, etc., are, I think, due to an arthritis attacking the abnormal joint. Though it is highly probable that successful reduction, particularly when this is accomplished at an early age and results in an anatomical cure approaching the perfect, will free the joint of this tendency to arthritis which is otherwise inevitable, at present we have no data from which to draw conclusions. Many more years must elapse before we can say that a *Class* 1 Cure will stand the test of age and other factors as well as a hip that has never been dislocated. Attention has already been drawn to the need of information on the fate of those hips which can only be placed as *Class* 2 Cures or 'anterior repositions'. It is at least doubtful in these cases whether we have really staved off the arthritis which would have attacked them sooner or later had nothing been done.

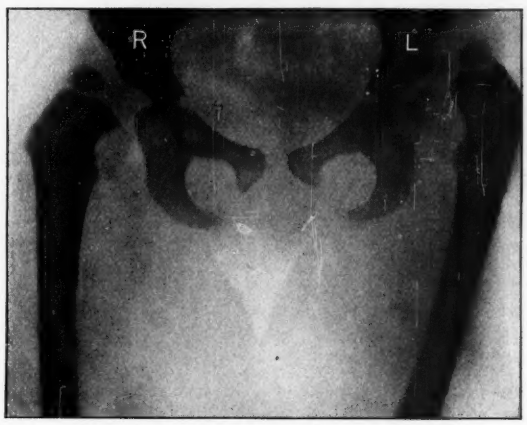



FIG. 46.—*Case* 13. Girl, age 2 years 10 months. Bilateral dislocation. Before operation.

**Traumatic and Late Re-dislocations.**—There are two cases of sudden re-dislocation—one case the result of a fall—in this series. One, a girl, age 4½ years at the time of the reduction, was apparently cured when last seen 4 years after operation. A fall resulted in sudden re-dislocation 9 years after reduction. Mr. Bankart, who saw her and reduced the dislocation, tells me the hip seems to be ankylosing. (This case is classed as a failure in my tables.) In another case, a girl of 5, the hip was 'put out' 7 months after reduction, i.e., soon after removal of the plaster. There was no definite fall to account for the dislocation. Reduction and fixation for a further 8 months had resulted in a *Class* 2 'anterior reposition'.

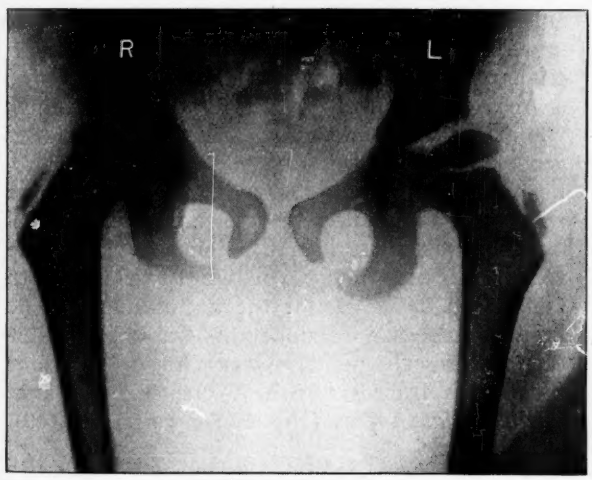



FIG. 47.—The same case as *Fig.* 46, 2¼ years after reduction, showing cure; acetabular upper lips still good.

Late re-dislocations without apparent cause are not common. Most hips which seem to relapse late have really been imperfect from the first. I have had, however, two cases which were true, though partial, late relapses. One was a 'cure' after 2½ years, the upper lip of the acetabulum being unusually well developed; but now, after 11 years, it is an 'anterior reposition'. The other, a bilateral case, age 2½ years, showed a double cure with well-formed upper lips after 2 years; the hips are said to have been perfect for 10 years, after which the left began to give trouble, and this is now an 'anterior reposition', while

the right is still cured (*Figs.* 46–49). Two other cases were thought to be cured 2 to 3 years after reduction, and are now 'anterior repositions'; but they were not at first the stable-looking joints seen in the two previous cases.

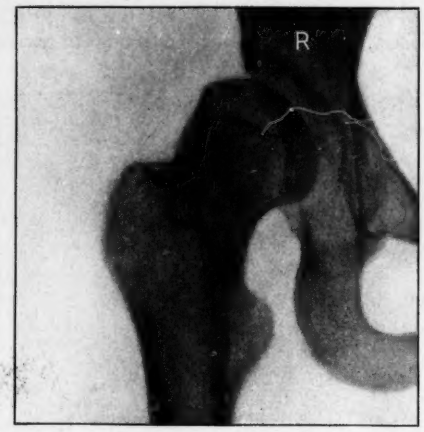



FIG. 48.—The same case as *Fig.* 46, showing right hip 14 years after reduction. *Class* 1 Cure, with poor acetabular upper lip and unstable-looking joint. Function perfect.

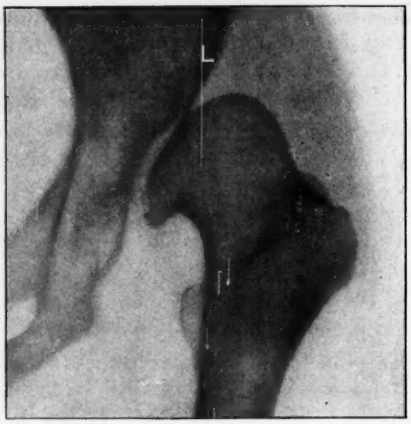



FIG. 49.—The same case as *Fig.* 46. Left hip 14 years after reduction, showing 'anterior reposition', *Class* 2. Function fair.

**Open Operation.**—There were 13 operations in the pre-war cases. Nine open reductions were attempted after manipulation alone had failed to reduce the dislocation or had been followed by relapse. In two of these reduction was not accomplished, while a third was so unstable that the attempt at a cure was abandoned. Infection occurred in one, which eventually ankylosed above the acetabulum. Unfortunately I have not been able to trace a single one of the remaining five cases, though two were known to be cures for 2½ and 4 years respectively, a third was 'in' though the joint was fixed by fibrous ankylosis as reported above, and one was an 'anterior reposition'. In three others in which the hip as reduced by manipulation was unstable, a small opening was made into the joint to verify the reduction, and then an attempt was made to fashion an upper lip for the acetabulum; while in a fourth case an upper lip was made without opening the joint. Only two of the four have been traced, of which one relapsed and one is a *Class* 1 Cure (*Fig.* 50; *see also Fig.* 40).

FIG. 50.—*Case* 15. Girl; bilateral dislocation. Both hips reduced at 3½ years; right hip treated by open operation and formation of an upper lip to the acetabulum. Radiogram of right hip 9½ years later showing *Class* 1 Cure, with good acetabular margin. Function excellent.

## CONCLUSIONS.

The following conclusions seem justified.

1. If cases are sent to the surgeon sufficiently early, i.e., before the end of the third year, an anatomical cure ought to be obtained by manipulative reduction in something like 75 per cent of the unilateral and 50 per cent of the bilateral cases. In the vast majority of these the function should be excellent, at any rate for many years.

2. Of those giving an imperfect result by the manipulative method, some additional 'cures' should be obtained by a second manipulative reduction, followed in two or three weeks' time by open operation, the object of which is the making of an upper lip for the acetabulum without opening the joint. (This I regard as a much less grave operation than open reduction.)

3. Open reduction should not be necessary in the younger cases, but is specially to be considered in those cases of the middle age-group in which manipulative reduction has proved impossible. Only in carefully selected cases should this operation be performed after the age of 6 years.

4. After reduction full right-angle abduction should be maintained for a minimum of six months.

5. Although some of the cases with an 'anterior reposition' show remarkably good functional results, we must, in the present state of our knowledge, hesitate to attribute to these patients any permanent advantage over the untreated cases.

6. Physical treatment after removal of the plaster case, in all but the youngest patients, may exert a permanent influence on the function of the hip, but it probably has no effect on the anatomical result.

Finally, I wish to express my gratitude for the care and trouble taken by Dr. Robert Knox and Dr. Bertram Shires over the radiograms.

# ACUTE PHLEGMONOUS GASTRITIS.

By CHARLES J. MacAULEY, Dublin.

This rare affection of the stomach is usually described as occurring in two forms, either as a circumscribed submucous abscess or as a diffuse purulent infiltration of the submucous coat. The localized variety appears to have been first noted by Varandaeus, as far back as 1620, while the earliest description of the diffuse type is attributed to Andral in 1839. In 1910, J. E. Adams recorded a case due to the pneumococcus, and in the same year Leith wrote the first comprehensive account of the disease to appear in English, in *Allbutt and Rolleston's System of Medicine*. Since 1910, no case, so far as I am aware, has been recorded in Great Britain or Ireland, but several papers have appeared in America in recent years, notably those of Rixford and Novak, while Sundberg has detailed 215 cases, including 17 from the clinics of Stockholm and Upsala.

It is said that a similar condition may occur in the duodenum, and Sherren (*Choyce's System of Surgery*, 1915) quotes Ungermann as having recently collected six cases of phlegmonous duodenitis, in three of which the disease was localized in the duodenum alone.

Phlegmonous gastritis may occur at any age, but is most common between 20 and 60, and is said to be much more frequent in men than in women.

**Etiology.**—Adams' case was due to the pneumococcus, but all the others in which bacteriological examination was made have been due to the streptococcus, generally in pure culture, but sometimes in mixed infection with the *Bacillus coli*.

In considering the possible portal of entry, the cases may be conveniently divided into two groups :—

*a.* Secondary Cases.—These form a small group in which an obvious lesion is present from which the suppurative process spreads, e.g., malignant or callous ulcer, or an operation wound. Thus, it has been known to follow gastro-enterostomy and gastrostomy. The path of invasion in such cases is clear.

*b.* Primary or Idiopathic Cases.—In these there is no discoverable lesion of the mucous membrane. Here we can only assume, in accordance with present-day conceptions, that the organism gains entrance through some minute abrasion of the mucous membrane, or is carried by the blood-stream from some distant focus. That entry takes place through the mucosa in the majority of cases is generally held. Thus, in all of Sundberg's personally observed cases there was a previous history of chronic gastritis, and in my own case dyspepsia had been present for some years. A previous history of chronic alcoholism is said to be frequent ; but recent cases, at any rate, afford very little evidence of such a connection.

Against the view that the infecting agent enters through traumatic or other lesions in the gastric epithelium, Shatara quotes the experiments of Symmers, who failed to produce the lesion in animals by feeding them on ground glass and inoculating streptococci and pneumococci by way of the blood-stream and stomach tube. That this evidence is by no means convincing, however, is shown by the work of Simmons and von Glann, who, after a series of careful experiments with ten dogs, conclude " that the ingestion of ground or powdered glass produces no lesion, either gross or microscopic, in the gastro-intestinal tract of dogs ".

That the path of infection may be by way of the blood in some cases would seem clear from the association which has been frequently noted of gastric phlegmon with conditions in which one might reasonably assume the presence of a blood infection.

Dittrich (quoted by Brinton) observed many cases of suppurative gastritis in 1851 during an epidemic of puerperal fever in Prag, and noted the frequent occurrence of erysipelas in such cases. In Lehnhoff's patient the abdominal attack followed immediately on what was believed to be an influenzal sore throat. Three of Rixford's cases occurred in the winter of 1916–17, during which an unusual number of severe streptococcal infections, especially sore throats, occurred in San Francisco. In a large group of cases, however, there has been no discernible lesion of the gastric mucosa and no primary focus has been found elsewhere, and in these so-called idiopathic cases it is commonly assumed that the micro-organisms gain access through some very minute breach in the mucosa. There is no record of blood cultures having been made in any of the cases, probably because the diagnosis has been made, at the earliest, only on the operation table, and few cases have survived more than a few days thereafter. In any case, as Rixford points out, positive findings would be of little value, since they might be secondary to the stomach lesion. In my case certainly there were all the clinical signs of a severe septicæmia. If one were to consider the origin of gastric phlegmon in the light of modern views on similar and allied conditions, the possibility would seem to be not too remote that the vast majority of idiopathic cases are of hæmatogenous origin. It is believed—and the belief is supported by considerable evidence—that infection of the wall of the gall-bladder is commonly derived from the blood-stream, whether portal or systemic, and the pathological picture in phlegmonous cholecystitis resembles in many ways that of phlegmonous gastritis. Rosenow has isolated streptococci from the bases of gastric and duodenal ulcers, and claims to have established by animal experiment their power of elective localization in these and other regions : and the primary foci, frequently in teeth or tonsils, may present no gross and obvious lesion, and are thereby liable to be overlooked. Of interest also in this connection is the work of Reeves on the gastric and duodenal blood-vessels, which indicates that the vessels in the submucosa of ulcer regions are longer, smaller, and have fewer anastomoses than elsewhere, thereby predisposing to thrombosis. "Since the vessels are more liable to be occluded by emboli, it is reasonable to suppose that they are an important factor in the production of ulcer by hæmatogenous infections." Gastric phlegmon appears to affect primarily the region which is so commonly the seat of peptic ulcer, since the circumscribed submucous abscess is always located at the pylorus, while the early cases of the diffuse type have all been limited to the same region. It is tempting, therefore, to assume that gastric phlegmon—which is almost always of streptococcal origin—may start in the same way as gastric ulcer, by hæmatogenous deposit, with the difference—of degree only—that the former, especially in its fulminating types, is due to a much more virulent infection, and one which is probably aided and accelerated by a diminished local and general resistance.

**Pathology.**—The suppurative process—having once started in the submucosa, generally at the pyloric end—may spread widely through the submucous tissue or may be localized to form an abscess, the extent of spread depending on the virulence of the infecting organism, and on the presence or absence of induration of the stomach wall which might be expected to act as a barrier. Thus, phlegmon starting in a growth or ulcer appears to be less fulminating in its onset and development than the primary cases.

The possible terminations of the process are :—

1. Perforation through the mucosa into the gastric lumen, with conceivable recovery. While such cases have been recorded, the correctness of a diagnosis based on pus in the vomit is open to considerable doubt.

2. Perforation through the serosa, with resultant peritonitis ; or extension of the infection through the serous coat, without actual rupture.

3. Death from toxæmia or septicæmia before rupture can occur. In 33 per cent of Sundberg's fatal cases nothing was found to indicate peritonitis.

4. Encapsulation, forming an abscess simulating a neoplasm, as in Novak's case.

It is interesting to note that, even in the diffuse forms, the suppurative process never seems to spread beyond the pyloric ring or cardia.

The naked-eye appearances of the diseased organ are given in the account of my own case.

**Symptomatology.**—In the majority of cases of the diffuse type the clinical picture is pretty definite. In the fully-developed stage, the features are: (1) Sudden onset of intense epigastric pain; (2) Vomiting, early and persistent, but not fæculent; (3) Marked prostration; (4) Fever, which often rises to 104°; (5) Epigastric tenderness and rigidity, often to left of middle line; (6) Leucocytosis (10,000 to 20,000—mainly polymorphonuclear); (7) Often congestion at the base of one or both lungs; (8) Dry brown tongue, intense thirst, often hiccough, and sometimes a tender mass in the epigastrium. The symptoms rapidly merge into those of profound and progressive peritonitis, which frequently precedes the end. Death takes place in three to ten days.

**Diagnosis.**—Novak says that in only a few instances (Chvostek, Dörbeck, M'Caskey), not all of established authenticity, is diagnosis said to have been made during life. Rixford made the diagnosis at operation by inserting a hypodermic needle into the stomach wall and withdrawing pus—a plan which has much to recommend it when the appearances of the stomach are suspicious. In my own case the picture of the stomach at operation was so striking that I had no hesitation in making the diagnosis, although my anæsthetist and assistant were frankly incredulous. In attempting to make a pre-operative diagnosis the following conditions have to be considered:—

1. *Basal Pneumonia.*—This is often closely simulated by the high fever, hurried respiration, and dullness at one or both lung bases. In cases of doubt Rixford advises exploratory laparotomy under local anæsthesia as being less dangerous than waiting, and as possibly the only certain means of making a diagnosis by exclusion at a sufficiently early period.

2. *Hæmorrhagic Pancreatitis.*—May be indistinguishable, but in pancreatitis fever is commonly absent. In a recent case of hæmorrhagic pancreatitis under my own care the temperature had been persistently subnormal, a feature which, combined with a rapid thready pulse and deep epigastric tenderness without rigidity, enabled me to make the diagnosis with a fair degree of confidence, which was justified by the operative findings.

3. *Perforation of a Gastric Ulcer.*—Resembles phlegmonous gastritis in its sudden onset, but differs from it in being followed almost at once by muscular rigidity over a widely increasing area, and by the absence of high fever. The terminal stages of both affections, being those of general peritonitis, are, however, likely to be indistinguishable.

4. *Acute Phlegmonous Cholecystitis.*—Here also the sudden onset and high fever show a close resemblance, but the symptoms in cholecystitis are right-sided, and the distended gall-bladder may be palpable. In my own case it was the only condition I could think of as filling the clinical picture, though the absence of tenderness and rigidity in the gall-bladder region was quite definite. Only in pneumonia is an exact pre-operative diagnosis necessary, since the other conditions demand immediate surgical intervention in any case. The disease so seldom comes within the domain of the practical surgeon, that unless he has previously met with such a case, he is unlikely to make any other diagnosis than that of some urgent condition in the upper abdomen which requires exploration.

**Treatment.**—When one considers the frequently fulminating nature of the disease, and the difficulties in the way of early diagnosis, it is not surprising that the records of operation in this condition are gloomy in the extreme. There are recorded only three operative recoveries in authentic cases, and these are to the credit of Bovée, Koenig, and Novak. The cases of Bovée and Koenig were of the diffuse variety, but limited to the pylorus, the operative procedures being incision and drainage by rubber tube in the former, and partial gastrectomy by the Kocher method in the latter. Novak's case was a localized abscess involving the pylorus and simulating a tumour; recovery followed partial gastrectomy by Balfour's modification of the Polya method. On ordinary surgical principles incisions into the stomach wall would be indicated, but such a procedure could scarcely afford adequate drainage in the diffuse type where both walls may be involved, and must almost inevitably lead to infection of the general peritoneal cavity. The only

treatment which offers any prospect of success is gastrectomy, and that only in cases where the process is localized and the line of section can be made through approximately normal stomach. Where the disease is secondary to cancer of the stomach even total gastrectomy is likely to be futile, and where the whole stomach is involved any form of operative treatment seems useless.

## REPORT OF CASE.

On Sunday night, Aug. 21, 1921, a stout woman, age 60, who had previously been in good health, was suddenly seized with intense abdominal pain and vomiting. Dr. F. Callaghan saw her late on the following night (Monday) and sent her immediately to hospital, where I saw her in consultation with him early on Tuesday morning.

EXAMINATION.—Her temperature, which had been 104° the previous night, was now 102·5°, the pulse-rate was 92, and the respirations 26. She looked gravely ill, and was groaning with pain, which she referred entirely to the epigastrium. She had vomited since admission, but there was nothing abnormal about the vomit. The tongue was dry and brown, respiration somewhat laboured, and she complained of great thirst. There was dullness at the base of the left lung, and a mitral systolic murmur. Examination of the abdomen showed distinct rigidity of the epigastrium, which was tender on deep palpation, the tenderness extending to the left of the middle line. The rest of the abdomen moved with respiration, was flaccid, and not tender. The gall-bladder was not palpable, and there was no alteration of liver dullness. Rectal examination was negative. Urine negative. Questions about her previous health elicited only a vague history of dyspepsia extending over years, for which she had never sought medical advice.

The diagnosis was a matter of great difficulty, and the following possibilities were considered.

1. *Gangrenous Cholecystitis.*—This was suggested by the sudden onset, high temperature and evidence of severe septic absorption, but negatived by the absence of tenderness or rigidity in the gall-bladder region, while the gall-bladder was not palpable.

2. *Perforated Gastric Ulcer.*—Was favoured by the acute epigastric pain, tenderness, and rigidity, but the high temperature and absence of signs of general peritoneal involvement at this stage were distinctly against such a view.

3. *Acute Pancreatitis.*—Could be neither affirmed nor excluded.

In the absence of a definite diagnosis it was nevertheless felt that we were confronted with an urgent inflammatory condition in the upper abdomen which demanded exploration. Immediate operation was advised.

ANÆSTHETIC. — Gas and ether was administered by Dr. Callaghan.

OPERATION.—Assisted by Mr. H. MacAuley, I made a right paramedian epigastric incision. There was no extravasation, no free fluid, no fat necrosis, and no signs of peritonitis. Gall-bladder, appendix, liver, and pancreas were all normal. The appearances of the stomach were very peculiar—it was hyperæmic and œdematous, its walls so thick that one could hardly palpate a lumen. It felt heavy, boggy, and inelastic, and could be brought up for inspection only with great difficulty. The whole appearances were those of acute inflammation of the stomach. While examining the pyloric end, which was somewhat thicker than the rest of the organ, a small amount of clear fluid slightly blood-stained was noticed in Morison's pouch—apparently exudate from the inflamed stomach. The process involved the whole stomach, the anterior wall of which showed numerous subperitoneal hæmorrhages, especially along the greater and lesser curvatures and at the cardiac end. There was no evidence of a perforation of either anterior or posterior wall. Owing to the fatty condition of the omenta it was difficult to detect glands, but I fancied I could palpate an enlarged gland in the gastrocolic omentum towards the pyloric end. There were no perigastric adhesions.

FIG. 51.—Section of stomach wall from the cardia to the pylorus, showing thickening and suppuration.

From the appearances of the stomach, I judged the condition to be acute phlegmonous gastritis. The only treatment that suggested itself was to make incisions into the œdematous walls; but as the entire stomach and both surfaces were obviously involved, I felt that any treatment would have been futile. The abdomen was therefore closed, and the patient returned to bed. Death took place four days from the onset of symptoms. Marked abdominal distention indicated a terminal peritonitis.

No complete autopsy was possible—but the wound was re-opened after death. The peritoneal cavity was full of dirty grey exudate. The stomach removed showed a tiny perforation in the midst of an ecchymotic area on the anterior surface near the cardia. On splitting the organ along the greater curvature, the walls were seen to be unusually thick ($\frac{1}{2}$ in. in places), with a layer of pus in the submucosa extending from cardia to pylorus. Pus exuded freely on compressing the edges, and when incisions were made into the posterior wall for the purpose of obtaining cultures, fluid pus poured out.

Bacteriological examination of the pus revealed a pure culture of *Streptococcus brevis*. The appearance of the cut edges is shown in the excellent coloured drawing made for me by Mr. A. K. Maxwell (*Fig.* 51). Careful examination of the mucosa failed to show any lesion.

Microscopic Appearances.—Sections were cut from the thick pyloric and less thick cardiac ends. In both the submucosa is greatly thickened and shows many small round cells, especially polymorphonuclears. Actual œdema is apparent. In sections stained by the Gram-Weigert method many cocci are seen, often arranged in short chains. The intact and excellent condition of the mucous membrane is noteworthy.

I am greatly indebted to Dr. E. W. Bowell, of the Clinical Research Association, who very kindly examined the slides. He could find no evidence of neoplasm in any of the sections, and regarded the condition as purely inflammatory.

---

REFERENCES.

Deaver and Ashhurst, *Surgery of the Upper Abdomen*, 2nd ed.
Rixford, *Ann. of Surg.*, 1917, Sept. (Bibliography.)
Lehnhoff, *Jour. Amer. Med. Assoc.*, 1917, March.
Shatara, *Ibid.*, 1918, Dec.
Simmons and von Glann, *Ibid.*
Novak, *Ibid.*, 1919, Oct. (Bibliography.)
Sundberg, *Nord. Med. Arkiv.* 1919, May (abstr. *Jour. Amer. Med. Assoc.*, 1919, lxxiii, 802).
Reeves, *Collected Papers of the Mayo Clinic*, 1919.
Rosenow, *Surg. Gynecol. and Obst.*, 1921, July.

## ACUTE PHLEGMONOUS GASTRITIS.

ILLUSTRATION AND NOTES OF A CASE FURNISHED BY SIR BERKELEY MOYNIHAN.

The patient, a boy, age 17, was taken ill a few hours after eating pork pie. He complained of acute abdominal pain, and there was exquisite epigastric tenderness.

The epigastrium was distended, and the abdomen, inflated in its upper part but retracted below, presented a very striking and unusual appearance.

FIG. 52.—Sir Berkeley Moynihan's case of phlegmonous gastritis.

The boy was very ill; the pulse was never less than 118; there were collapse, vomiting, and profound prostration, which ended in death about thirty-eight hours after the onset of symptoms. At the post-mortem a typical and most acute phlegmonous gastritis was found. No lesion of the mucous membrane of the stomach could be seen (*Fig* 52).

# TUBERCULOUS CHANCRE.

By J. A. NIXON and A. RENDLE SHORT, Bristol.

There is a variety of tuberculosis of the skin which so closely resembles a primary syphilitic sore that, on the rare occasions when it occurs, it is likely to be diagnosed as extra-genital chancre. Hitherto, if this lesion has been recognized at all, writers have included it under the term tuberculosis verrucosa cutis, or verruca necrogenica. It is true some authors mention that T. verrucosa has occasionally to be distinguished from extra-genital chancre ; but they fail to see that when a tuberculous ulcer resembles a syphilitic chancre it has not the wart-like appearance that justifies the term 'verruca'. Thus it happens that the diagnosis of verruca necrogenica does not suggest itself to the observer, and the possibility of the lesion being tuberculous is overlooked.

Grancher and Hutinel[1] give instances of inoculation tuberculosis, including Tscherning's frequently quoted case of a servant girl's finger inoculated by the broken spit-cup of a consumptive. Sequeira,[2] in his description of T. verrucosa, says that two types may be recognized. In the first a small red swelling develops at the site of inoculation, and upon it a small pustule appears. "The swelling slowly enlarges to form a warty nodule with an infiltrated base, surrounded by a zone of erythema. . . . the lymphatic glands enlarge early. In one such case where the lesion was at the root of the nose, we were for some time in doubt whether the sore was not syphilitic, as there was a hard bubo under the chin." The same author in *Allbutt and Rolleston*[3] speaks of some cases of T. verrucosa that have to be distinguished from blastomycosis, extra-genital chancre, and carcinoma. Gaucher[4] mentions tuberculous ulcers of the skin, which, he adds, should not be mistaken for hard chancre, since the latter has an infiltrated base, no tendency to extend, and is accompanied by glandular induration—characters that he evidently does not ascribe to the tuberculous lesion. Wilson,[5] describing a series of cases of primary tuberculosis of the penis following circumcision, says that the condition has been mistaken for syphilis, chancroid, and cancer.

But the majority of these descriptions either specifically state that the lesion is wart-like, or make use of the term 'verruca'. In the cases dealt with in this paper none of the lesions was in any degree wart-like, and so long as inoculation tuberculosis is described as causing a warty or verrucous lesion, observers who rely on book descriptions will fail to diagnose the true nature of the cases.

In certain individuals direct implantation of tubercle bacilli into the skin by means of a cut or abrasion gives rise to a localized indurated papule. This papule develops into a small indolent ulcer of cartilaginous consistency, having an edge that is slightly ramparted and translucent. It is attended by enlargement of the nearest group of lymphatic glands, which may be mistaken for a sentinel bubo. The induration of the ulcer causes it to be mistaken for extra-genital chancre, although syphilitic chancres of the skin are usually not indurated, but assume a raspberry appearance which the tuberculous ulcer never possesses. Sometimes the tuberculous ulcer may look exceedingly like rodent ulcer ; but in the latter case there is an absence of glandular enlargement.

These primary tuberculous ulcers, which from their appearance and behaviour we have called tuberculous chancres, are probably due to inoculation of tubercle bacilli into persons who have a latent tuberculous infection. Their tissues become intolerant to the presence of the bacilli. The ulcer at the site of a subsequent inoculation represents the efforts of the tissues to expel the bacilli by local necrosis where they have lodged ; Koch first described this peculiar reaction which results from a previous infection, and it is known as Koch's phenomenon.

The diagnosis of tuberculous chancre can only be made by excising part or the whole of the ulcer and examining the tissue for tubercle bacilli, either by staining or, if this proves negative, by animal inoculation. A negative result should never be accepted without animal inoculation.

The following cases illustrate the character and behaviour of this form of tuberculous lesion :—

*Case* 1.—Mrs. B., age 57, sent by Dr. Myles, of Clifton, came under observation in October, 1920, complaining of a pimple on her chin for the past four months. She thought that it had been caused by her son kissing her. He was dying of pulmonary consumption.

On the point of her chin there was a raised papule about one centimetre in diameter. It was pale pink in colour, not ulcerated, but had a slightly ramparted edge, and felt as hard as a true Hunterian chancre ; it was non-adherent to the deep structures. Below it there were a few solitary transparent nodules in the skin, the size of pin's heads. The submental gland was enlarged to the size of a walnut and constituted a sentinel bubo.

The sore and glands were excised. Microscopic sections showed the presence of tubercle bacilli, and animal inoculation (undertaken by Professor Lyle Cummins) demonstrated that the bacilli were of human type. The scar of the first operation broke down, and a second wider excision led to complete and firm healing. The sections are shown in *Figs.* 53, 54.

FIG. 53.—*Case* 1. Section of tuberculous chancre (*low power*).

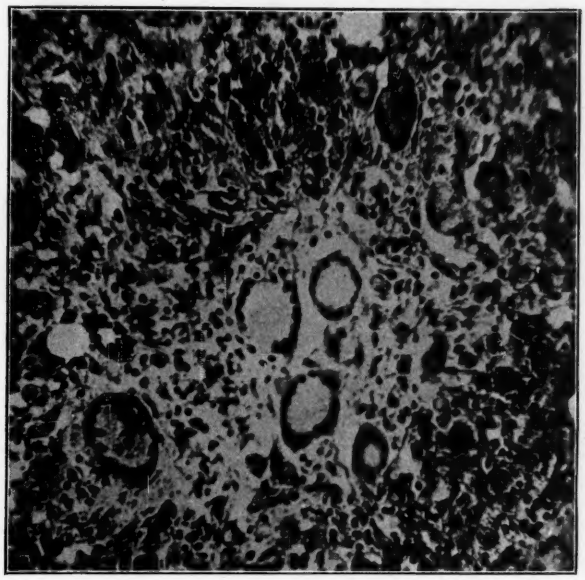


FIG. 54.—*Case* 1. Section of tuberculous chancre (*high power*).

*Case* 2.—Margaret N., age 6, fell and cut her knee while at the seaside in May, 1919. A small ulcer formed which remained open for three months. The ulcer was as large as a florin, situated over the middle of the right patella. Its colour was pale purple. The centre was raw, and discharged only scanty serum, showing no sign of granulation. The margin was raised, and formed a rolled rampart not undermined. The ulcer was indurated and non-adherent to the patella. A large bubo formed in the groin, which suppurated.

In August, 1919, the ulcer was excised and a large mass of glands dissected out of the groin by Mr. Burton, of Cromer. The child made an uneventful recovery, and shows no other sign of tuberculosis. Tubercle bacilli were demonstrated in the skin of the ulcer and in the glands. There was no evidence of tuberculosis in any member of the family or of the household.

*Case* 3.—Fred. P., age 13, was admitted to St. Bartholomew's Hospital in June, 1900. In April of that year he had fallen and struck the left side of his face on a desk at school. The left eye was bloodshot next morning. Three days after the accident a painful swelling developed in front of the left ear. This suppurated, and was incised a month later. During the whole time the conjunctiva of the left eye had remained inflamed. A small hard tumour was found on the conjunctiva in the fornix at the external canthus, with swelling of the lids and general injection. The surface of the lump was ragged, tuberous, and ulcerated at its lower part, covered with a thin puriform secretion. The rest of the inner surface of the lower lid was studded with small translucent granules not unlike miliary tubercles. One was situated on the corneal margin, looking like a phlyctenule. The pre-auricular gland on this side was swollen, and still discharging pus.

Mr. Jessop diagnosed the case as a syphilitic chancre of the eyelid. Mr. Alfred Willett and Mr. Vernon thought it was probably tuberculous. The tumour and the gland were excised by Mr. Jessop, and proved by animal inoculation (Professor Andrewes) to be tuberculous.

The boy made an excellent recovery.

*Case* 4.—A.B., age 34, widow living in the country. Patient was seen in November, 1921. She complained of a nodule on the upper lip, with a two months' history. It began as a small vesicle in the middle line, on the mucocutaneous margin ; a week after a child bumped up against it and bruised it. Recently it had been growing rapidly.

On examination there was found a red proliferating growth, about the size of a filbert, extending from the filtrum of the nose to the border of the lip, and slightly overhanging the lower lip (*Fig.* 55). It was firm, slightly ulcerated on the surface, and redder than a primary

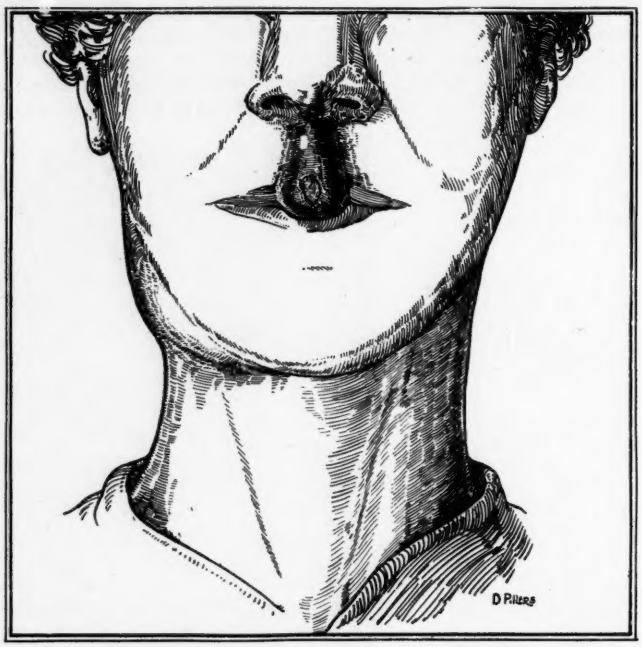



FIG. 55.—*Case* 4. Tuberculous chancre of the lip. Shows the dusky-red hypertrophic swelling, the superficial ulceration, and the enlarged gland in the neck.

chancre usually is. There was a hard indolent lymphatic gland beneath the right lower jaw in the submaxillary region. There were no secondaries. Wassermann was negative. Temperature normal. It was regarded as without doubt a primary chancre, with the usual bubo. Four professional surgeons saw it, and all thought it typical. Several of them had acted or were still acting as venereal clinic special officers.

Four doses of novarsenobenzol were given, but the condition did not improve, beyond healing of the superficial ulceration. It was therefore excised, and the pathological report showed unmistakable tuberculosis. She did well.

---

BIBLIOGRAPHY.

[1] *Dictionnaire encyclopédique des Sciences médicales*, Paris, Masson, 1887, Art. "Phthisie", p. 534.
[2] SEQUEIRA, *Diseases of the Skin*, London, 1911, 196.
[3] ALLBUTT and ROLLESTON, *System of Medicine*, ix, 484.
[4] GAUCHER, *Diseases of the Skin*, London, 1910, 320.
[5] WILSON and WARTHIN, *Ann. of Surg.*, 1912, lv, 305.

# PLASTIC REPAIR OF THE FACE AND HAND.

By J. J. M. SHAW, Edinburgh.

As exemplifying two of the methods which have proved of great service in plastic repair —the tube pedicle, and the Thiersch graft on mould—the following description of the disablements and treatment of a severely-burned patient may be of interest. In a recent article by Lieut.-Colonel H. P. Pickerill and Mr. J. Renfrew White, the application of the tube-pedicle method to gunshot wounds of the face and to areas of chronic ulceration in the limbs was set forth with great clearness (*British Journal of Surgery*, January, 1922, p. 321). The present paper will therefore be restricted to the treatment of the effects of burns in an illustrative case.

L. R. B., age 20, of the R.A.F., was burned by ignition of petrol in a motor launch in Poole harbour in September, 1919. All his shipmates succumbed, and for a considerable time the patient's own chance of survival was uncertain. He was treated for more than six months in a local hospital, in which efforts were directed mainly to saving his life—the prevention of his contracture deformities, in the early months at least, being relegated to a secondary position. Later he was sent to Woolwich Military Hospital, and thence transferred to my wards at Queen's Hospital, Sidcup, in March, 1920.

The illustrations of the progress of the case are almost self-explanatory, but a brief description of the operations will make the various steps more clear.

**The Face.** (*Figs.* 56–62.)

1. A strip of skin and platysma, 5 in. long by 1½ in. wide, was dissected up on each side of the neck. The upper ends were left attached, and the lower remained united by a bridge formed by a portion of the skin and subcutaneous tissue of the chest which corresponded exactly to the requirements of covering for the chin as measured by a pattern of tinfoil. The neck strips were then tubed by suture of their free margins with vaselined linen thread, and the skin edges bordering the raw areas were undercut and sutured together beneath the pedicle with silkworm gut. In this first stage, the bridge was demarcated, but only partially freed, in order to avoid too great a primary demand upon the circulatory supply and lymph escape via the pedicles. The raw areas in the neighbourhood of the bridge were dressed with ambrine. The areas of skin-supply are shown in the diagrams.

2. A month later, the dense scar-tissue of the chin was removed. The bridge, having been completely severed from the chest, was turned up into position and sutured with three points of catgut, one at the symphysis and one at each foramen menti, in order to create slight natural depressions, and with horsehair around the lip margins and lower border of the chin, where comparatively healthy skin adjoined. A group of tiny epithelial plants from the abdomen were spread over the raw surface of the chest, according to the Ollier-Thiersch technique, and dressed with gauze wrung out of normal saline. This area rapidly epithelialized, and, with massage and oil inunction, the scar ultimately became soft and pliant.

3. After the lapse of ten weeks, such scarred skin of the nose as remained was turned down, as shown in the diagram, to form a nasal lining. The neck ends of the pedicles were severed, partially opened out, and turned up symmetrically to form the nose.

4. Three weeks later, the unhealthy tissue was removed from the upper lip. The pedicles were divided at the tip of the nose and sutured into the raw area, the free ends meeting at the mid-line of the lip.

Thus in four operations the new coverings for chin, nose, and upper and lower lips were provided. No dressings were used upon the face at any stage. The extent of

FIGS. 56–61.—From photographs illustrating the progress of the operations on the face.

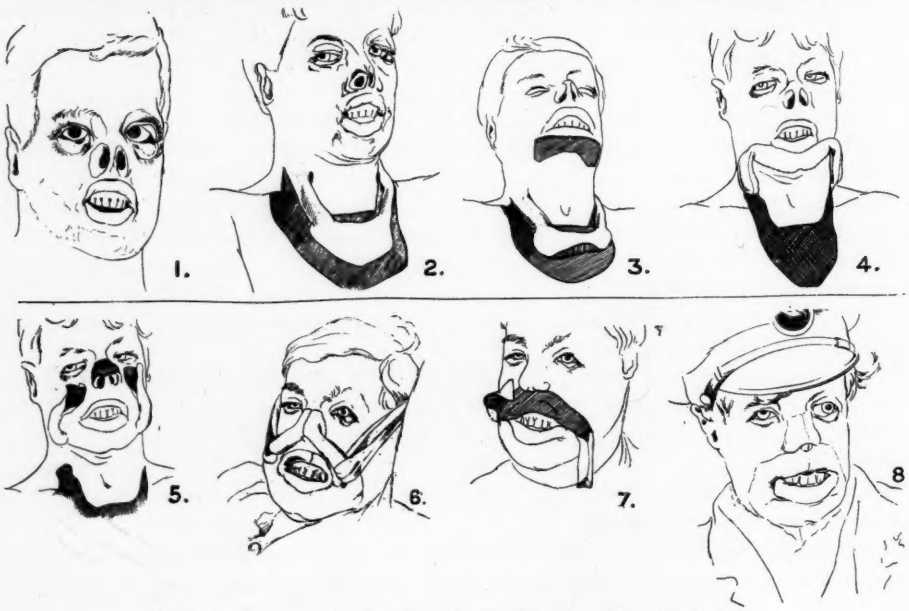
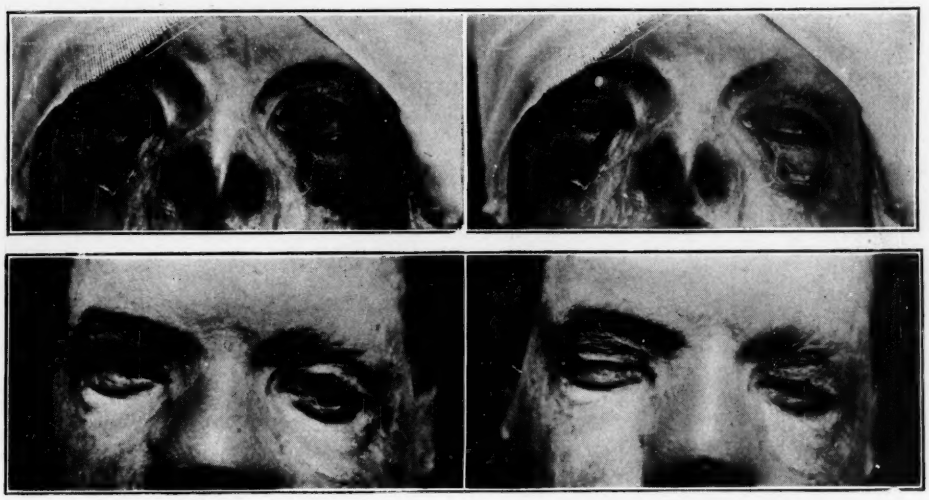



FIG. 62.—Diagrams showing stages (1–8) of the operations on the face.

retraction at the root of the nose and in the new lining of the nostrils was slightly underestimated, with the result that the damaged columella was incompletely concealed ; but a small prop of cartilage or local advancement at a later stage will easily remedy this defect. Freed from attachment in the circumoral region, the remaining portion of the skin of the cheek retracted satisfactorily and pulled the scar upwards and outwards at the line of union to the position of the normal nasolabial fold. It also softened to a remarkable degree, and lost its florid and rough look. The final result of this relaxation was a weather-beaten appearance over and below the malar prominence where the colour is usually somewhat deepened. The treatment of the ectropion of the lower lids also helped towards this end.

**The Eyes.** (*Figs.* 63–65.)

The dressings shown in the early photograph (*Fig.* 63) were necessitated by the



FIGS. 63, 64.—The eyes of the patient open and closed, before and after the operation.

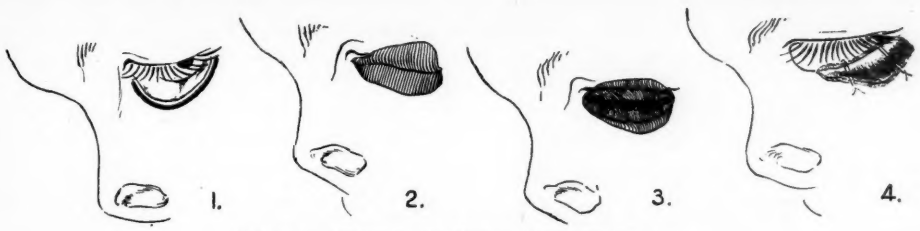



FIG. 65.—Diagram of the steps of the operation (1–4).

condition of the scalp, and by the ulceration over both temporomandibular joints when admitted.

The ectropion of the eyelids, both upper and lower, on both sides, was dealt with by the application of Thiersch grafts upon moulds. This method has been fully described in his admirable book by my late senior colleague, Mr. H. D. Gillies, by whom its utility was early recognized and applied in inlays of the mouth, nose, and eye sockets, and for ectropion.

The dental composition known as 'stent' is softened by heat and then pressed into a hollow created by an incision alongside the ciliary margin and the freeing of the lid by dissection. The mould, when set, is removed, and around it is wrapped a Thiersch graft, raw surface outwards : graft and mould are re-inserted into the prepared bed and almost buried by cross-suturing. Ten days later, the mould is removed and the cavity is found to be lined with smooth and healthy epithelium. This process is usefully practised in

the ectropion following severe lupus ; indeed, the whole clinical picture of this case was not dissimilar to the effects of that disease when it has been allowed to progress beyond the stage of primary excision followed by plastic restitution, which, as for rodent ulcer, appears to be the most reasonable line of treatment in those cases in which local applications have been thoroughly tried but have proved ineffective. The accompanying diagrams (*Fig.* 65) serve to illustrate the method ; and the photographs, with eyes closed and open before and after operation, show the degree of restitution which was effected.

**The Hands.** (*Figs.* 66–68.)

As the photograph of the right hand indicates, the hands and wrists were very

FIGS. 66, 67.—Hand before and after operation.

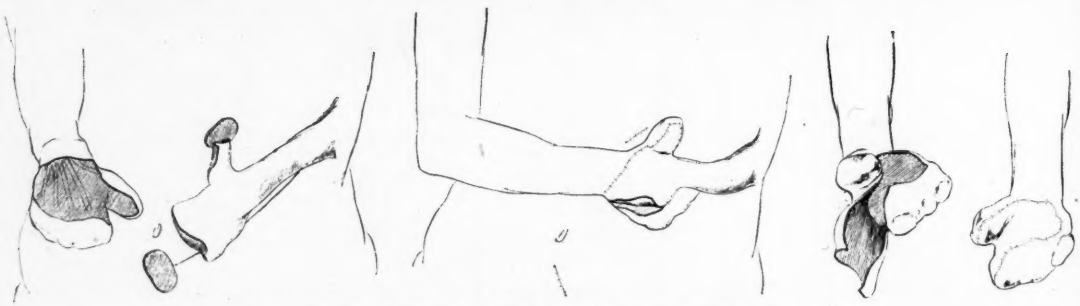


FIG. 68.—Showing four stages of the grafting operations.

severely burned. The wrists were fixed in a position of extreme flexion. and large unhealed areas were present on the dorsal aspects, which had been dressed for many months with the accompaniment of severe pain. The palms were filled with thickened and sodden masses of epithelium. On the left side, two sinuses led down in the direction of the head of the middle metacarpal bone. The distal phalanges of all fingers had disappeared, and several necrosing pieces of bone protruded from the shapeless masses which represented the fused remains of fingers and thumbs of both hands. Small blebs on the dorsal aspects, which occasionally broke down and emitted foul-smelling sebaceous matter,

indicated the sites of the digital clefts. On account of the fusion of the stumps in dense scar-tissue, no trace of independent movement was discernible in fingers or thumbs, although the patient still preserved a subjective sense of control of each digit. Radiographic examination indicated, and subsequent dissection confirmed the fact, that actual synostosis had taken place between the proximal phalanges of the left middle and ring fingers.

The patient was right-handed. Sepsis and pain were greater on the left side. It was impossible to obtain from the abdomen sufficient covering for both hands without the production of a disabling scar, as, for the right hand alone, I estimated that 38 square inches of skin were required. In view of these facts, amputation was performed at the lowest level of unscarred skin in the middle third of the left forearm, and an artificial arm of the 'Cauet' type, fitted later, gave him a limb of considerable usefulness.

1. For the right hand, an abdominal pedicle was cut, 9 in. long by 3 in. wide, slightly aslant the natural skin fold, and in the vascular and trophic line of supply. At right angles to the main pedicle, a thumb extension was also fashioned. By a little undercutting of the skin and relaxation by flexion at the hips, the edges were easily apposed beneath the pedicle, and primary union resulted.

2. The second stage was carried out three months later, but this long interval was due to the difficulty of so reducing the sepsis of the hand that no unnecessary risk of losing a portion of the pedicle by this means would be incurred on attachment.

The dorsum of the hand was cleaned, the extensor tendons defined, and the thumb freed by removal of the dense scar-tissue which had bound it to the stump of the index finger. The medial ends of the pedicle and thumb extension were divided and opened out. The hand was then held in position while the new coverings were sutured over the raw areas. The remainder of the pedicle, designed for ultimate application to the palm, was thus left unopened at this stage, and its range of movement obviated the need for absolute and uncomfortable fixation; this, with the absence of any raw surface on hand or abdomen, is of considerable importance in view of the discomfort and sepsis occasionally produced by the 'flap' method in this region.

3. In three weeks' time sound union had been established, along with a dependable reverse circulation, which had been accelerated by frequent constriction of the abdominal attachment. The pedicle was severed, opened, and applied to the palm and radial side of the stump of the index. On healing, this produced a full thumb sulcus and a pliable web which gave excellent movement. The patient could write well, and for the first time in a year was able to feed himself with a fork or spoon.

4. A second pedicle was cut on the right side of the abdomen to cover the remainder of the hand, consisting of the ulnar border, the stump of the little finger, a concavity created by the removal of the stumps of the middle and ring fingers, together with the heads of their corresponding metacarpals and, finally, the outer aspect of the thumb. This was carried out in stages of operation similar to the other.

The operations for facial repair, for the eyes, and for the hands, were carried out concurrently, and necessitated fourteen general anæsthetics of gas and oxygen, which were administered intratracheally except when treatment was directed only to the hands or abdomen.

The patient's health improved steadily as his septic foci were eliminated and as he was enabled to go about in the open air with eyes adequately protected from dust and glare, and with the consciousness that his appearance had ceased to be repulsive. The psychic effect of any obvious disfigurement, whether due to trauma, disease, or a congenital affection such as nævus, is always a factor worthy of consideration, and it was pleasing to note the steady mental uplift in this stout-hearted lad as his many disablements were ameliorated.

# A CONTRIBUTION TO THE PATHOLOGY AND ETIOLOGY OF OSTEO-ARTHRITIS: WITH OBSERVATIONS UPON THE PRINCIPLES UNDERLYING ITS SURGICAL TREATMENT.*

By A. G. TIMBRELL FISHER, London.

## INTRODUCTORY.

There can be no doubt that the condition called by English writers 'osteo-arthritis' has afflicted not only mankind but the lower animals, from remote periods in the earth's history. We find its stigmata in the skeletons of prehistoric animals and in human remains of considerable antiquity, for among the bones of ancient Egyptians at the Royal College of Surgeons of England are several exhibiting these changes, and in hieroglyphic writing the 'determinative' for old age was the figure of a man crippled with arthritis. Moreover, we find no race or clime to be exempt from the disease.

The pathological changes are of very great interest and importance from their extraordinary diversity; for in the same joint we may see the phenomena of repair, inflammation, and new growth merging indistinguishably into one another. Moreover, accompanying or following the cellular proliferations, are unequivocal signs of degeneration. A striking feature, and one which distinguishes the disease from the more acute and probably infective group of conditions known as 'rheumatoid arthritis', is the almost invariable absence of small-cell infiltration.

There can be little doubt that in osteo-arthritis we are faced with a borderland between a frankly inflammatory condition and a neoplasm of the joint structures.

The etiology of osteo-arthritis presents us with a difficult problem. It would appear, however, that research into this subject is urgently needed, not only in order that we may be able, from a knowledge of the cause, to treat this extremely common, universal, and crippling disease on scientific lines; but, in addition, such a line of research may eventually throw some light upon the pathogenesis of neoplasms.

In this paper a section is devoted to some largely experimental observations upon joint physiology, because it was felt that our knowledge concerning the basal principles of the physiology of the joints leaves much to be desired, and it was thought that a study of this might throw some light upon the peculiar pathological features of osteo-arthritis. The grosser anatomical features of the disease have been so carefully described by Adams and others that a description of these is purposely omitted. The morbid histology of the earlier stages, which appears hitherto to have received less attention than it deserves, has been investigated more fully in order to ascertain what light these earlier changes might throw upon etiological problems. Symptomatology and treatment are given in a summarized form from considerations of space, and will receive more detailed notice elsewhere. The etiological observations are of a preliminary nature, as research is being continued into this aspect of the problem.

**Nomenclature.**—Much of the existing confusion concerning osteo-arthritis can be traced to the fact that many writers have invented descriptive terms for the disease in which an attempt is made to embody what appears to be its principal pathological characteristics. We have already noted how manifold and diverse these changes may

---

* Embodying the Hunterian lecture delivered at the Royal College of Surgeons of England, and constituting an abstract of a preliminary report to the Medical Research Council, who have generously defrayed the expenses of the research.

be. This appears to be the explanation of the fact that certain American workers have christened the disease by names which indicate diametrically opposite conditions.

Goldthwait, for example, classifies chronic arthritis into: (*a*) Infectious arthritis; (*b*) Atrophic arthritis; (*c*) Hypertrophic arthritis. Nichols and Richardson have introduced the terms 'proliferative' and 'degenerative' arthritis, corresponding respectively to the 'atrophic' and 'hypertrophic' arthritis of Goldthwait, or to the 'rheumatoid arthritis' and 'osteo-arthritis' of English authors.

## EXPERIMENTAL AND OTHER OBSERVATIONS UPON THE APPLIED ANATOMY AND PHYSIOLOGY OF ARTICULAR CARTILAGE:

### WITH SPECIAL REFERENCE TO ITS STRUCTURE, MODE OF NUTRITION, AND TO THE REPAIR OF WOUNDS THEREIN.

It is a healthy sign that modern physiologists are devoting attention to the structure and physiology of the individual cells—a movement that must lead ere long to significant revelations. In pathology it is only by a study of the individual cells under abnormal conditions that we can hope for a clearer comprehension of disease.

The complicated problems connected with the etiology and pathology of osteo-arthritis are so intimately bound up with the structure and physiology of the articular cartilage that it is essential to have a clear idea of this structure and physiology. My researches into the latter furnish, I venture to believe, the clue to many of the pathological phenomena of osteo-arthritis.

Let us, before discussing the anatomy and microscopic structure of articular cartilage, glance at another specialized form of hyaline cartilage.

**Costal Cartilage.**—The periphery is formed by a connective-tissue perichondrium. As these connective-tissue cells are traced towards the deeper parts the cells become larger, although still of connective-tissue type, and not surrounded by any matrix. If traced still further, these cells indistinguishably merge with the proper cartilage cells. The latter, in the central portion of the cartilage, are seen to be large, somewhat angular cells occurring in groups of two, three, or four. In sections of adult costal cartilage stained by carbol-thionin, Professor Shattock observed that the matrix immediately surrounding the cartilage cells stains a deep claret colour (*see Fig.* 72). This more deeply stained portion of the matrix is evidently of more recent origin and contains a larger proportion of mucin to collagen than the older matrix, since, as is well known, carbol-thionin stains mucin freely. There can be little doubt that the central groups of cartilage cells are derived from the peripheral by a process of proliferation. Occasionally, ill-defined fibres can be seen in the matrix of costal cartilage, and, as age advances, lime salts may be deposited in the matrix, or, as is well known, the cartilage may become completely ensheathed with bone continuous with the rib and sternum.

**Repair in Costal Cartilage.**—It appears that the fully formed cartilage cells in the centre have little power of undergoing proliferation, and that repair takes place by means of the perichondrium.

*Experiment* 1.—A median longitudinal section was made in the 5th costal cartilage of a rabbit through its whole thickness. Ten weeks later microscopic examination of the divided portion of costal cartilage reveals that the cartilage cells on either side of the incision show no sign of proliferation; but that there is a thin strand of connective tissue *derived from the perichondrium* occupying the cleft in the centre of the costal cartilage.

**The Vitality of the Cartilage Cells.**—In a Hunterian lecture upon loose bodies in joints, I demonstrated that in those loose bodies of the traumatic or 'classical' type which contain both cartilage and bone, and which have been for some time quite free in the joint cavity, the cartilage cells retain their vitality, whereas the majority of the bone cells die. To test further the behaviour of cartilage cells when transplanted beneath the skin of their host, I would adduce the following experiment:—

*Experiment* 2.—A portion of costal cartilage was resected with its perichondrium and placed in saline solution at body temperature. A separate incision was next made through the skin covering the anterior aspect of the left side of the chest, and the portion of costal cartilage was introduced through this and pushed up towards the axilla. The small incision was separately sutured. Ten weeks later the portion of costal cartilage was found to be firmly incorporated with the subcutaneous tissues, and was removed.

Microscopical examination shows the cartilage cells to have retained their normal characteristics and to contain well-stained nuclei. At the periphery the perichondrium can be seen, and, external to this, a delicate investment of connective tissue derived from the subcutaneous tissues.

The marked vitality of the cartilage cell when compared with the bone cell requires emphasis in order to explain many of the phenomena of osteo-arthritis.

**Articular Cartilage.**—A reference to *Fig.* 69 will show the main characteristics of articular cartilage, as it illustrates the different characteristics of the lateral and central parts, to which I hold many of the most striking pathological features are due.

It will perhaps avoid confusion if we discuss the structure of articular cartilage under two headings, viz., the central and the lateral articular area.

1. Central Articular Area.—The superficial stratum is seen to consist of flattened cells arranged in groups which lie parallel to the surface. If the immediate surface is carefully examined it will be seen that it is constituted by a well-defined regular curvi-

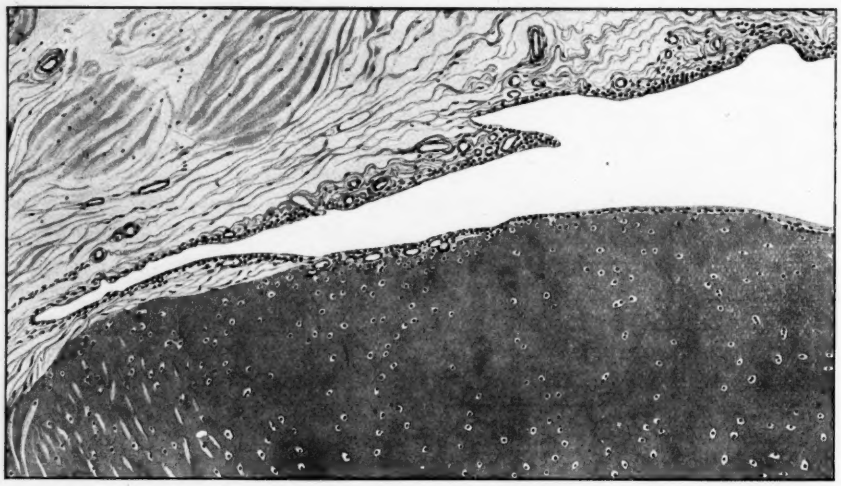


Fig. 69.—Vertical section of normal articular cartilage from lower part of human patella, showing synovial membrane above, which extends for a certain distance at the margin over the articular cartilage. (Two inch obj.)

linear margin which is devoid of any actual cell covering, and is evidently formed of matrix. Henle has described a delicate layer of cells (perichondrium) upon the actual free surface; but investigation convinces me that this must be very rare in the normal adult, although it unquestionably exists at an earlier stage of development. A point of importance is that the horizontal group of cells of the superficial stratum shows no sign of degeneracy or diminished vitality, but even in the case of the most superficial the nuclei stain well, and there is no indication that they are other than normal and healthy cells.

In the intermediate zone the groups of cells are more irregularly disposed, and in the deeper zone the cell groups are arranged vertically. Ogston's main conclusions were that articular cartilage is continually renewing itself from the focus of central growth; that it grows in two directions; and that it develops in the direction of the joint an effete layer that is worn away by the joint movements.

However, examination of normal cartilage reveals no justification for the assumption that it develops towards the joint this effete layer, or that this contributes in any way to the synovial fluid.

It seems clear that, far from being degenerate, these superficial cells are the source from which the deeper cells are derived, and that from developmental and other reasons they are analogous to the superficial cells of the lateral portion of the articular cartilage, or to the perichondrial cells of costal cartilage.

2. Lateral Articular Area (*see Fig.* 69).—The lateral portion somewhat closely resembles those varieties of hyaline cartilage which are furnished with a perichondrium, for the surface of the cartilage is covered laterally by a delicate extension of the synovial membrane. When traced centralwards the connective tissue is reduced to a single layer of close-set endothelial cells; these subsequently produce hyaline matrix in which they become buried, so that the more central parts of the investing cartilage consist at the free surface of matrix, i.e., cartilaginous. At the edge the articular cartilage becomes markedly fibrillated, and merges into the fibrous tissue, beyond which it is furnished with capillaries, derived from the circulus, without there being any marked increase of cellularity accompanying the transition. In the thin synovial layer over the lateral articulating area lie capillaries derived from the circulus articuli vasculosus of William Hunter. This lateral part is therefore far better nourished than the central. This fact is of fundamental importance and, in my opinion, is the key to many of the phenomena of osteo-arthritis; for my theory, as will be seen later, is that the central part of the articular cartilage responds to the cause of osteo-arthritis by degeneration, whereas the lateral part proliferates, owing to its richer nutrient supply.

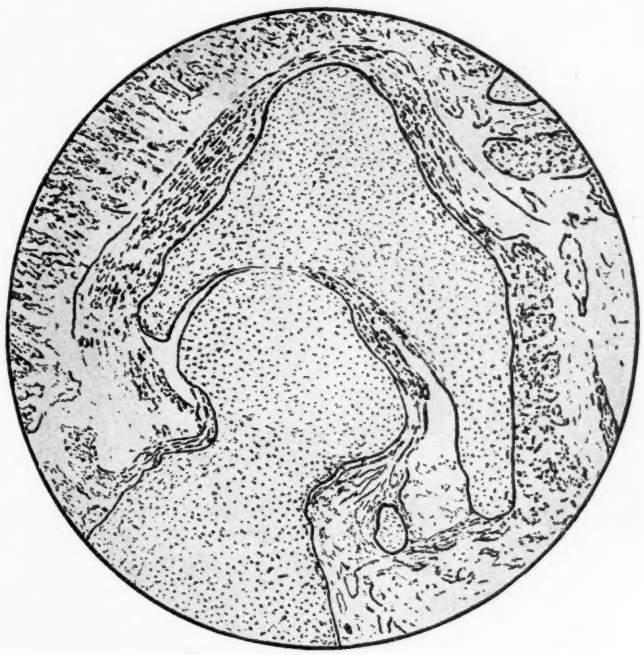


Fig. 70.—Section through hip-joint of human embryo 4·5 cm. (9th to 10th week) showing commencing cleavage of the mesenchyma. (Drawn by Dr. Gladstone.)

**Development of Articular Cartilage.**—This difference in structure of the central and lateral portions of the articular cartilage is capable of an explanation on developmental grounds. Towards the termination of the second month, the joint cavities have appeared—a split occurring in the mesenchymatous tissue, which usually commences laterally. This is well shown in *Fig.* 70, (kindly drawn for me by Dr. Gladstone).

At the fourth month of intra-uterine life the surface of the joint cartilage is still covered by this layer of connective tissue. This is the stage which is normally found throughout life in certain birds—notably the ostrich.

With the increasing movements of the child before birth the perichondrial layer *gradually recedes* from the more central parts of the articular surface, but at birth it still strays for a little way over its edge (*Fig.* 71). Microscopically, however, the connective-tissue layer can be traced beyond the naked-eye delimitation.

Shortly after the child begins to walk the extension of the synovial membrane over the lateral margin of the articular cartilage makes a further slight regression, but soon assumes its permanent relationship. No perichondrium is present over the more central part, yet there can be no doubt, from a study of their structure, staining reactions, and of their development and comparative anatomy, that these cells have the same function

as the perichondrial cells of the lateral part of the articular cartilage and are the parent cells of the more fully-developed cartilage cells in the deeper parts.

**Nutrition of Articular Cartilage.**—This is another question of fundamental importance, and one concerning which there has hitherto been a grave lapse in our knowledge. In a paper entitled "Of the Structure and Diseases of Articular Cartilages" William Hunter first described the circulus articuli vasculosus lying near the margin of the articular cartilage, and in younger subjects sending off-shoots on to the articular surface.

He states: "The distribution of the blood-vessels to the articulating cartilages is very peculiar, and seems calculated for obviating great inconvenience. Had they run on the outer surface, the pressure and motion of the two cartilages must infallibly have occasioned frequent obstructions, inflammations, etc., which would soon have rendered our motions painful, and at last entirely deprived us of them. But by creeping round the cartilaginous brim where there is little friction, or under the cartilage, where there is none, they are perfectly well defended from such accidents". The outstanding fact remains that Hunter believed that the circulus plays an important part in the nutrition of articular cartilage.

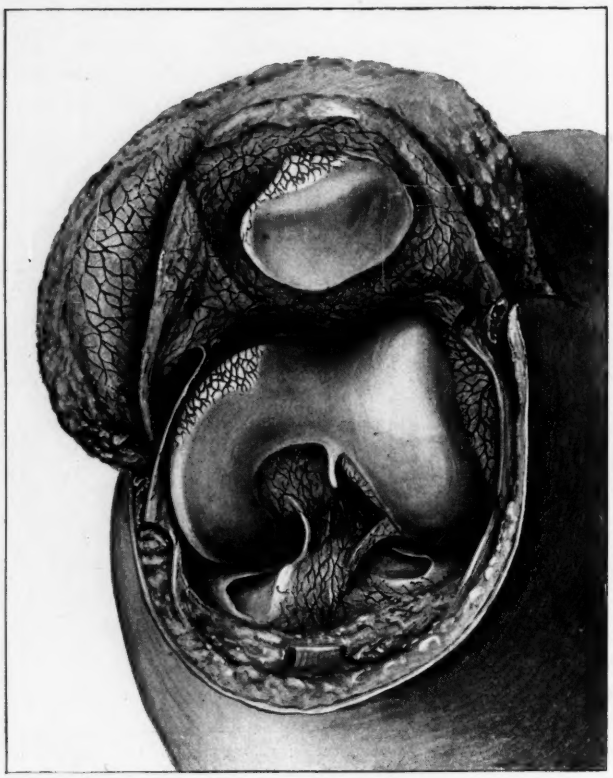


FIG. 71.—Blood-vessels of synovial membrane and circulus articuli vasculosus in injected knee-joint of human full-time fœtus.

From the developmental point of view and from that of comparative anatomy, the extent to which the minute branches of the circulus penetrate over the articular cartilage depends upon the degree of extension of the synovial membrane over its surface.

*Specimen B* 171, R.C.S. Museum, shows the circulus articuli vasculosus in the knee-joint of an ostrich, and was probably injected by William Hunter himself nearly two hundred years ago, and in *Fig.* 71 is shown the condition in the human full-time fœtus. The minute injected vessels stray for a short distance at certain spots over the surface of the articular cartilage. Toynbee came to the conclusion that the principal source of nutrition of adult articular cartilage consisted in the lymph exuded from the large and convoluted vessels lying beneath it in the cancellous spaces.

Recently there has been an attempt to attribute an important part in the nourishment of articular cartilage to the synovial fluid. An argument in favour of this view is the continued growth, while free in the joint, of loose bodies of the 'classical' type. However, a loose body usually acts as an irritant, and causes a greater or less degree of synovitis, with an outpouring of fluid rich in albumin which cannot in any sense of the word be designated 'normal' synovial fluid. My analyses, which I now show for the first time, reveal that the normal fluid contains such a low protein content that it is very doubtful whether it plays more than a small part in nourishing the articular cartilage. (*See* Table.)

| | Synovial Fluid | | Lymph Plasma |
|---|---|---|---|
| *Average Personal Cases.* | | | |
| | Human | Oxen | Human |
| Total Solids - - | 4·41 per cent - | 2·023 per cent | 4·2–6·5 per cent |
| Protein Content - | 1·6 ,, - | 0·92 ,, | 3·5–4·3 ,, |
| Mucin - - - | 1·95 ,, - | 0·1303 ,, | — |

My conclusions are as follows :—

That the deeper stratum of the articular cartilage is largely nourished in the manner described by Toynbee.

That the superficial stratum of the central articular area is nourished by the synovial fluid, and that the remainder of the articular cartilage receives its nutrient supply from the circulus articuli vasculosus. It will be seen that, in the infective and toxic types, this arterial circle is an important medium by which toxins attack the joint.

The subarticular bony lamella cannot be said to form an impenetrable barrier, since after an injection of carmine and gelatin the colour readily permeates this zone. Neither can the calcified zone of the articular cartilage be said to form a serious barrier. The question next arises, How does the nutrient fluid gain access to the cartilage cells? No definite lymphatics with an endothelial lining have ever been demonstrated in articular cartilage. Professor Shattock has recently discovered that if cartilage is stained by carbol-thionin, which stains mucin pink (*Fig.* 72), it will be seen that the zone of matrix immediately surrounding the cell groups is stained pink, and is evidently the most recently formed and more mucinous part. In a well-stained section it will be seen that the pink zones branch and intercommunicate. In the superficial part of the articular cartilage the meshwork is horizontal; in the middle zone more irregular; and in the deeper zone the meshes lie vertically.

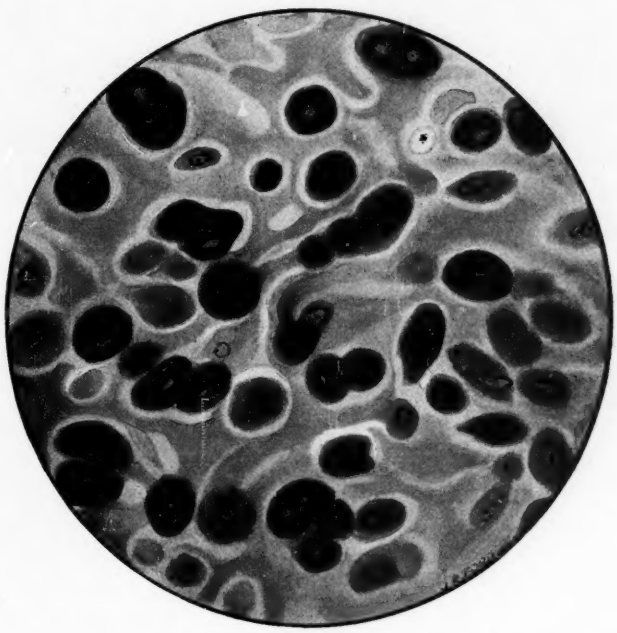


FIG. 72.—Cartilage stained by carbol-thionin which reveals the lines of softer matrix along which possibly the inhibition of nutrient fluid takes place. (Two-thirds obj.)

My own theory is that the articular cartilage receives its nourishment from plasma that percolates along the meshwork formed by this more mucinous part of the cartilage matrix which surrounds the cell groups, and the pathological changes seen in the infective and toxic groups of osteo-arthritis, including the 'senile', strongly suggest that toxic substances percolate along these same nutrient paths.

**Repair in Articular Cartilage.**—The phenomena of repair in articular cartilage throw considerable light upon osteo-arthritis, especially the traumatic type.

Redfern, who performed a large number of experiments upon animals in order to investigate the mode of repair in articular cartilage, came to the conclusion that incisions experimentally made remained open for *long periods*, and that when repair took place

eventually, the bond of union was formed of connective tissue derived from the cartilage cells at the margin of the incision. There was no actual formation of new cartilage cells. He also found that incisions in the lateral portions of the articular cartilage healed sooner than those in the central parts. On each side of his incisions there was some feeble and quite local proliferation of the cartilage cells. I have repeated certain of Redfern's experiments, and have performed others which appear not only to confirm the views concerning the nutrition of articular cartilage enunciated above, but also to afford some explanation of the osteophytic developments which are such a marked feature of osteo-arthritis.

*Experiment* 3.—Right knee-joint of rabbit opened from the inner side. Small portion of articular cartilage with a portion of the subjacent bone chiselled off—the portion involving the inner lip of the trochlear surface of the femur and a portion of the internal femoral condyle. The subsequent changes in this traumatic loose body I have described elsewhere.

FIG. 73.—Experiment 3. Reparative formation of cartilage after artificial detachment of the lateral part of the trochlear surface of the femur.

The animal was killed twenty-two weeks later, and the articular surface of the femur whence the small fragment had been detached was seen to be smoothly healed over and covered by a white and glistening substance. Microscopical examination revealed the following (*Fig.* 73) :—

The slight depression in the curvilinear contour represents the spot where the original articular cartilage becomes continuous with the reparative formation over the chiselled surface. The reparative tissue consists of well-formed cartilage covered superficially by a clearly defined layer of connective tissue. Some of this cartilage is probably of the nature of cartilaginous callus, and appears to be derived from the connective-tissue cells of the cancellous spaces exposed by the trauma. The more superficial cartilage cells are formed from the connective tissue on the surface, but it is quite clear that much of the cartilage is derived from the deeper layer of the articular cartilage, which can be seen actively proliferating.

This experiment demonstrates that *the lateral part of the articular cartilage is capable of a certain amount of repair by formation of new cartilage*, and this phenomenon can be explained on anatomical and physiological grounds, for we have already shown how the lateral part of the articular cartilage receives far better nourishment than the central parts, and, moreover, is furnished with a perichondrium.

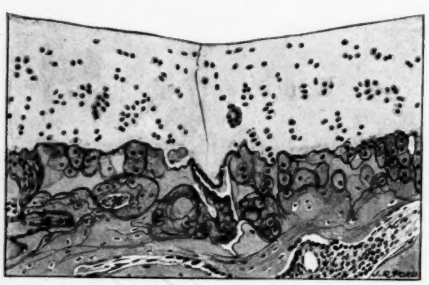


FIG. 74.—Experiment 7. Incision in centre of trochlear surface of the femur. Feeble proliferation of cartilage cells. (Two-thirds obj.)

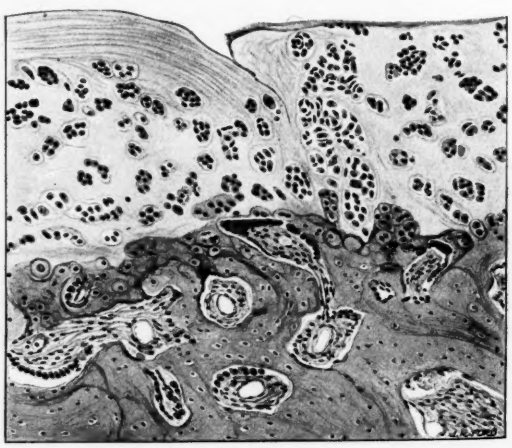


FIG. 75.—Experiment 7. Incision in lateral part of trochlear surface. Marked proliferation of cartilage. (Two-thirds obj.)

*Experiment* 4.—Right knee-joint of a rabbit opened and the articular cartilage of the trochlear surface of the femur longitudinally divided, (*a*) in the centre, (*b*) near lateral edge. One month later the rabbit was killed, and the portion of the trochlear surface examined microscopically. It will be seen from *Figs.* 74 and 75 that both incisions are plainly visible. There is little, if any proliferation at the sides of the central incision (*Fig.* 74), but on either side of the lateral incision (*Fig.* 75) there is a well-marked proliferation of cartilage cells.

This experiment again demonstrated the greater vitality of the lateral portions of articular cartilage.

### Experimental Production of Traumatic Osteo-arthritis.

*Experiment* 5.—Right knee-joint of rabbit. The central part of the articular cartilage covering the trochlear surface of the femur and patellar articular surface was pared away down to the calcified zone, and the joint was closed. After a few days the animal exhibited no limp or any sign of disability. Six weeks later it was killed. The naked-eye appearance of the joint is seen in *Fig.* 76.

Fig. 76.—Experiment 5. Experimental production of traumatic osteo-arthritis in knee-joint of rabbit. (× 2.)

Microscopical examination of a transverse section of the trochlear surface is of considerable interest (*Fig.* 77). It will be seen that there is no sign of repair of the pared surface—indeed it has undergone necrosis. The contrast between the necrotic central parts and the lateral portion, which extends for some distance over the central portion, is very marked. The most interesting feature is that the cartilage of the lateral part is in process of active proliferation. The explanation of this occurrence undoubtedly is that the central part, owing to its poorer nutrition, is incapable of repair, and that proliferation of the lateral part must be regarded as compensatory.

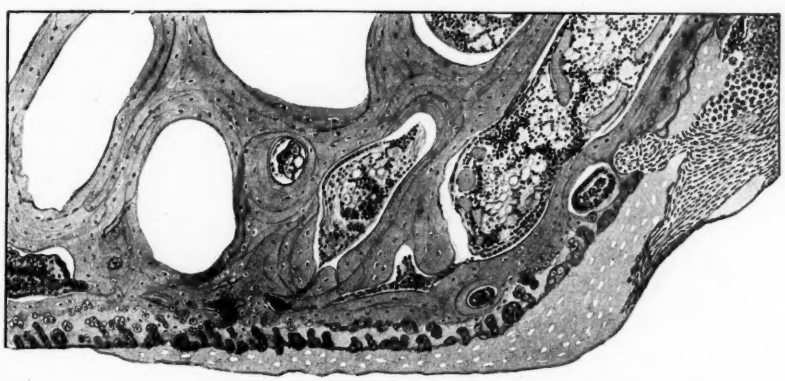


Fig. 77.—Experiment 5. Compensatory proliferation of lateral part of articular cartilage after experimental removal and damage to central portion. (Two-thirds obj.)

Fig. 78.—Experiment 6. Osteo-arthritic changes caused by radium. (× 2.)

*Experiment* 6.—Traumatic osteo-arthritis experimentally produced in a rabbit by the action of radium.

A tube containing 0·150 mgrm. radium (kindly lent me by Professor Lazarus-Barlow) was fixed against the inner border of the internal condyle of the femur near its junction with the trochlear surface. Four weeks later the articular cartilage at the edge nearest the radium tube is seen to have undergone well-marked proliferation, and below and more central to this zone is an area of degeneration (*Fig.* 78). This experiment shows, moreover, the influence that the vascularity of the parts exerts upon the action of radium emanations.

**The Effects of the Lack of Cartilaginous Apposition and of Prolonged Cartilaginous Apposition upon Articular Cartilage.**—

*Experiment* 7.—The knee of a rabbit was fully flexed and immobilized by a staple driven on either side into the lower end of the femur and upper end of the tibia—the joint not being opened. A plaster bandage was applied to complete immobilization. The rabbit was killed six weeks later and a post-mortem performed. The staples had become loose and there was a considerable amount of new periosteal bone formed in the vicinity of the holes in the femur and tibia. No intra-articular adhesions between the cartilaginous surfaces were present, and the latter were everywhere normal, save over the trochlear surface of the femur, which, owing to full flexion of the joint, had not been in contact with a cartilaginous surface. Here the cartilage had disappeared. Full extension was prevented by scarring of the joint capsule.

*Experiment* 8.—The patella was completely dislocated to outer side of joint. After death ten weeks later, the articular cartilage of the patella and trochlear surface had almost entirely disappeared, evidently owing to the lack of cartilaginous apposition. Articular cartilage elsewhere was normal. No compensatory formations had as yet occurred at the margin.

These and similar experiments have an important bearing upon the pathology of osteo-arthritis, as they show that although in all probability mere immobility of a joint, provided it be healthy and that cartilaginous surfaces be in apposition, causes no degenerative changes in the latter, yet lack of cartilaginous apposition usually causes the articular cartilage to undergo transformation into connective tissue. Redfern found that the articular cartilage also underwent this change after experimental amputations through joints. It is clear that this change may occur in the human subject after amputation. *Specimens Nos.* 440.1 *and* 442.2, R. C. S. Museum, show the lower ends of the femora from cases of amputation through the knee-joint. In both cases the articular cartilage is very thin, and has in places undergone transformation into connective tissue.

We frequently see examples of the same occurrence in old unreduced dislocations, both congenital and acquired, and in various deformities; and in these cases, as will be mentioned later, compensatory osteophytic formations may actually occur at the articular margins from the physiological reasons already given.

**Physiological Effects of Trauma upon Articular Cartilage.**—Experiments were performed, of which the following is an example, to ascertain whether an isolated series of traumata was in itself sufficient to produce changes in the articular cartilages.

*Experiment* 9.—A rabbit was anæsthetized and—the knee being flexed to bring the patella in contact with the trochlear surface of the femur, and the joint covered with a cloth—a series of rapid blows was applied to the patella with a hammer so that both it and the femur were subjected to repeated percussion for about two minutes. Five weeks later the rabbit was killed and the articular surfaces were found to be perfectly normal and free from fibrillation.

This experiment should be compared with *Experiment* 11, described later, where a suspension of *Streptococcus salivarius* isolated from a case of pyorrhœa was injected after percussion of a joint.

## PATHOLOGY.

### *A.* CHANGES IN THE ARTICULAR CARTILAGE.

1. **Central Part of the Articulating Area.**—Although not quite the earliest observable change, the most striking early departure from the normal consists in the well-known 'fibrillation' (*Figs.* 80 and 84) of the central area of the articular cartilage. The poorer nutrition of the central area already referred to appears to be at least as important a factor in its earlier involvement as the greater pressure to which it is normally subjected. In the knee-joint the articular surface of the patella and trochlear surface of the femur are, in my experience, almost invariably first affected.

The term 'fibrillation' is somewhat misleading, as I am unable to agree that the change consists in the formation of true connective-tissue fibres, but find that in the cases examined by me there is a splitting of the matrix without fibrous metaplasia. Careful examination in early cases will often reveal that the first fibrils formed lie horizontally (*see* extreme left of *Fig.* 84), and in their length occasionally far exceed the normal thickness

of articular cartilage. The staining by muci-carmine of normal cartilage reveals the reason for this disposition: since the more collaginous portions of the matrix lie superficially in horizontal strata, but are vertically disposed in the deeper portion. When vertically fractured, articular cartilage shows the same vertical striæ, and my theory is that the fibrillation in osteo-arthritis is due to the persistence of the strata of more collaginous matrix. In certain cases I have observed cystic degeneration of the articular cartilage.

*Case* 16 (personal series). Male, age 68. The knee-joint presented well-marked signs of osteo-arthritis. The portion that was examined microscopically was the posterior part of the internal condyle including the chondro-osteophyte.

In the substance of the articular cartilage is a sharply circumscribed cyst filled with finely-molecular stained material (*Fig.* 79). Smaller secondary cysts lie by its side and are probably continuous. By its side is a focus showing the initial stage of cyst formation; the matrix becoming finely alveolated and the cartilage cells disappearing. In a yet earlier stage areas of the matrix lose their homogeneity and coloration, and become finely granular, the cells disappearing. In many spots liquefaction is taking place in connection with cell groups, leading to the formation of microcysts. Changes are slightly more marked in the superficial part of the cartilage, the free surface of which is here and there minutely pitted, presumably from the rupture of microcysts. The cyst lies at the base of a sessile osteophyte which is of rudimentary size and consists of cartilage superficially as far as, and including, the summit. This cartilage presents the characters of the normal articular in regard to the arrangements of the cell groups, and on the deep side presents the ordinary calcified zone, which is continuous with that of the articular cartilage of the joint. Beyond the summit the cartilage merges into a well-defined layer of connective tissue by an ordinary process of metaplasia, fibre replacing the matrix. Beneath this there is a well-formed and continuous lamella of normal bone, and further outward, beyond the limit of the osteophyte, the fibrous covering is resolvable into two layers. One is of more open connective tissue furnished with delicate projecting folds covered with a well-marked layer of cells more than one in depth (synovial membrane). Beneath this the fibrous tissue is denser, lies directly on the bone, and represents periosteum. The structure of the deeper part of the osteophyte is cancellous, with very open connective tissue occupying its spaces, and without any obvious fat cells.

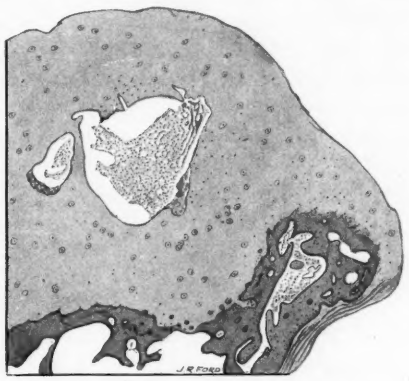


FIG. 79.—Cystic degeneration of articular cartilage near base of osteophyte.

*Epi-articular Ecchondroses.*—Not infrequently, the surface of the articular cartilage is rendered irregular by smooth rounded elevations due to the invasion of the deeper layers of the cartilage by vascular inroads of osteoblasts actively forming new bone, the cartilage cells simultaneously proliferating. Professor Shattock most appropriately named these nodular formations 'epi-articular ecchondroses' to distinguish them from the 'peri-articular ecchondroses' at the articular edges. As the changes progress, the cartilage gradually disappears from the central articular area, revealing the subjacent bone, the changes in which will be shortly described.

2. **Lateral Part of the Articulating Area.**—The important differences, not only in structure but in mode of nutrition, between the lateral and central portions to which we have already referred, explain the marked difference in the reaction of these parts to the cause of osteo-arthritis.

The well-known 'lipping' of the articular margins, in my experience, always succeeds the degenerative changes in the central areas. It is clear that the newly-formed cartilage is largely formed by the synovial perichondrium, since, when traced from the surface

towards the deeper parts, all the gradations from the connective-tissue cells of this perichondrium to fully-formed cartilage cells may be seen. The theory of Cornil and Ranvier which figures so largely in text-books, that the perichondrium merely prevents the proliferating cartilage cells from escaping into the joint, is not confirmed by my observations.

Some of the principal microscopic features of a chondro-osteophyte are exemplified by the following description of these formations at two different spots from the knee-joint of *Case* 24 (personal series).

*a.* Section (not figured) through a portion of the posterior aspect of the internal femoral condyle, including a small recurved osteophyte. The bone is of open texture containing fatty marrow covered with cartilage, in the deeper part of which there is an irregular violet zone of calcification. Near this zone there are a certain number of protrusions of cellular connective tissue, some of which also occur into the cartilage of the osteophyte itself, and others towards the articulating area of the cartilage (early epi-articular formations). The osteogenetic processes of connective tissue are richly provided with cells, and in one case its continuity with the bone-marrow through a constricted neck was readily traceable : the marrow immediately beyond the neck on the side of the shaft is well-formed adipose tissue, and in the neck itself the connective tissue is being converted into fat.

The general articular cartilage shows a certain amount of horizontal fibrillation at the free surface and a little proliferation of cartilage cells.

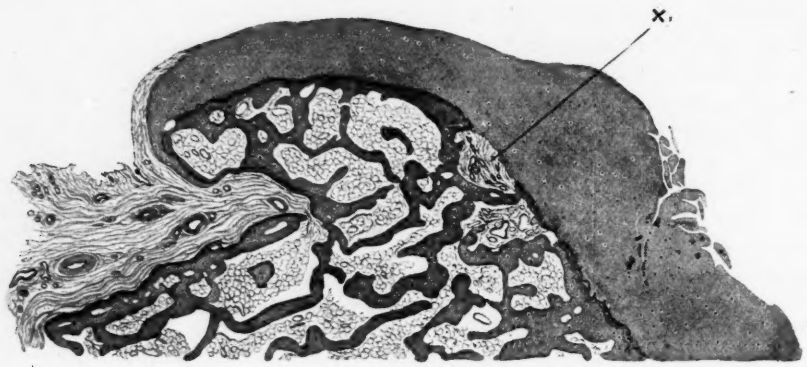



FIG. 80.—Transverse section showing early changes in articular cartilage, and structure of chondro-osteophyte. Normal vessels in synovial membrane. X = the triangular focus of connective tissue referred to in text. (Two-thirds obj.)

*b.* Another portion of articular surface including the lipped margin (*Fig.* 80), reveals the same general appearances as in the last described. However, at one spot near the base of the osteophyte there is, on the deep side of the articular cartilage, a triangular focus of vascular connective tissue. The tissue is lax in character, well furnished with nuclei, and merges at its base into the superadjacent cartilage, *from which it is clearly derived by a process of metaplasia.*

Sections of synovial membrane from the immediate vicinity of the articular edge show perfectly normal structure, without any sclerosis or thrombosis of capillaries or arterioles. The villi are abnormally voluminous, the investing cells intact and devoid of any small-celled infiltration, either polymorphonuclear or lymphocytic. The vessels in the subsynovial fat are quite normal in structure, and patulous.

Although the above is the usual mode of formation of a chondro-osteophyte, occasionally a development of cartilage in a synovial fold may become superimposed upon the lateral portion of the articular cartilage with which it fuses. In rare cases the articular cartilage may be buried beneath a layer of newly-formed bone formed in this manner (*Fig.* 81).

Although at first formed of cartilage only, the chondrophyte is invaded by osteoblasts, so that the cartilage is reduced to a thin layer on the surface (*Figs.* 79 and 80). This eventually undergoes similar degenerative changes, and may disappear, and the subjacent bone become eburnated; showing that the formations actually extend the articular surface in many cases, and are to a certain extent compensatory.

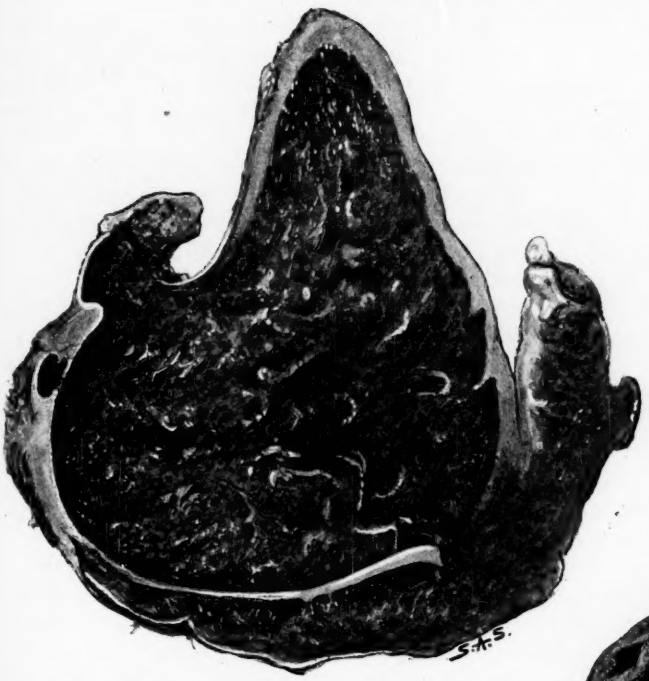


FIG. 81.—Specimen No. 695. St. Bart.'s Hosp. Museum. Articular cartilage partially buried beneath newly-formed bone.

In some cases the under surface of an osteophyte presents supporting buttresses resembling those in the roof of a Gothic cathedral (*Fig.* 82). The part played by these buttresses is clear when we remember that the cancellous spaces of an osteophyte are of extremely open and rarefied texture (*Fig.* 80), and the contents largely adipose tissue. Beyond the articulating surface of a chondro-osteophyte the new formation is usually recurved, so that at first the movements of the joint remain comparatively unimpaired. Impairment of movement by osteophytes is often due to the fact that the joint has not been regularly put through its full range of movement.

FIG. 82.—Specimen No. 1916. R.C.S. Museum. Supporting bony buttresses on under surface of osteophytic formations.

**Purposive Chondro-osteophytic Formations.**—In very many cases, although the production of osteophytes is excessive and may interfere with movement, or cause pain by pressure upon adjacent structures, yet we are often able to see evidence of definite purpose underlying these formations. The response of the central area of the articular cartilage to the cause of osteo-arthritis is by degeneration, whereas the better nourished lateral part proliferates. The latter may be regarded as Nature's effort to make good the loss of the central portions.

An excellent example of this is seen in the changes that the femoral head undergoes.

*Fig.* 83 shows the successive changes as exemplified by three different specimens from Guy's Hospital Pathological Museum. The upper drawing shows the head of the femur surrounded to an equal extent on all sides by an osteophytic outgrowth. The middle drawing shows that the upper part of the head has become flattened from pressure atrophy, and that the lower part of the osteophytic ring has undergone compensatory enlargement.

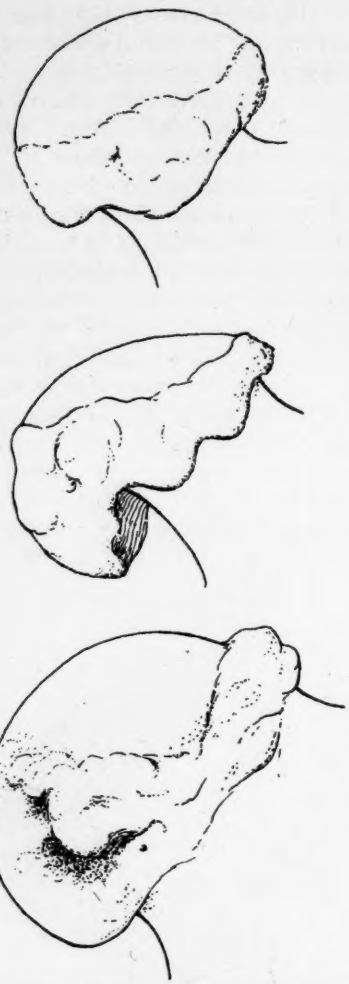


FIG. 83.—Nos. 4569, 4570, 4571. Guy's Hospital Museum. Purposive compensatory chondro-osteophytic formations in head of femur.

In the lower figure the lower part of the osteophytic development now forms a smooth articulating surface continuous with the remnant of the femoral head. The actual angle formed by the neck with the shaft remains unaltered.

**Chondro-osteophytes in Rheumatoid Arthritis.**—Although we occasionally see cases that present anomalous features, and occasionally the two conditions may be associated in the same patient, yet typical cases of osteo-arthritis and rheumatoid arthritis present quite definite clinical and pathological features. The picture presented by a typical case of rheumatoid arthritis is that of a subacute non-suppurative arthritis similar to certain forms of arthritis of known infective origin, such as gonorrhœal. The first and most marked inflammatory changes occur in the synovial membrane and capsular structures, giving rise to the typical 'spindle-shaped' swelling of the joint. Dr. Strangeways has carefully described these changes.

A very important distinguishing factor lies in the fact that rheumatoid arthritis is associated with a far greater amount of protective muscular spasm, and this leads to limitation of joint movement, and, as the result of this, there is nothing to prevent the pannus of granulation tissue from the synovial membrane extending over the surface of the articular cartilage and often leading to the disappearance of the latter. The ultimate result is therefore, in most cases, ankylosis between joint surfaces, which may be partial, complete, fibrous, cartilaginous, or bony.

In certain cases where ankylosis has been prevented, I have observed the formation of true compensatory chondro-osteophytes at those situations where the lateral portion of the articular cartilage has not been destroyed by the synovial pannus. These may exactly resemble those occurring in osteo-arthritis, and indeed it may be said that osteo-arthritis has supervened upon rheumatoid arthritis. *Specimens* 2081 *and* 2179 in the Research Hospital, Cambridge, kindly lent me by Dr. Strangeways, are good examples of the conditions described above.

### *B.* CHANGES IN THE ORIGINAL BONE.

If vertical sections are made through the articular end at different stages, I have observed that before the subarticular lamella of bone is actually exposed, it has already begun to undergo sclerosis, and the increased thickness of this bony layer beneath a patch of degenerate cartilage may be very striking. This remarkable change is evidently compensatory, since the bone is deprived of its normal protection. The invasion of the peri- and epi-articular ecchondroses by outgrowths from the bone has been referred to above.

Some further changes of great interest in the bone are exemplified in *Figs.* 84 and 85 from *Case* 27 (personal series).

A section through the patella (*Fig.* 84) shows the most peripheral part of the cartilage still of normal thickness and the artificial 'flaking' due to detachment of the flat-celled layer at the surface—*the cells being still living.* More centrally there is a second vertical-

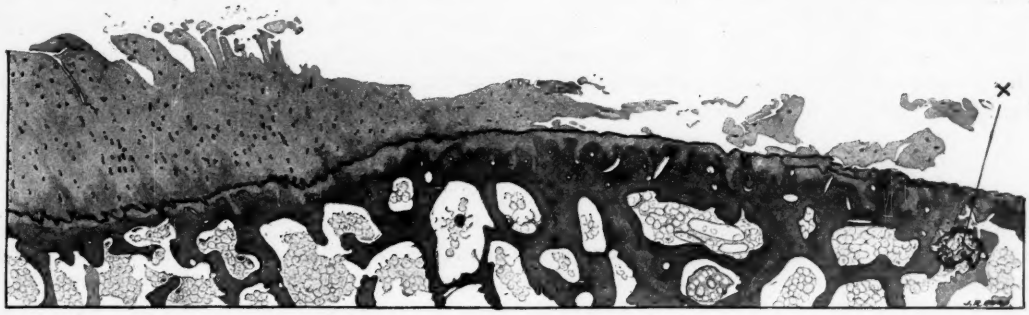



FIG. 84.—Transverse section of patella from *Case* 27. For description see text. X = cartilaginous nodule represented under higher magnification in *Fig.* 85. (Two-thirds obj.)

splitting in the cartilage; the cell nuclei retain their stain, and there is no obvious formation of fibre. Still more centralwards the cartilage becomes thinner, the cells remaining healthy, till it disappears, after breaking up into irregular fragments. The exposed articulating area here consists of very dense bone, obviously due to sclerosis of the normal cancellous tissue.

For a short way the osseous trabeculæ continued from the sclerotic layer are thickened. At one spot immediately below the sclerotic zone there is a microscopic island of hyaline cartilage, and in the centre of this there is a small pseudo-cyst resulting from liquefaction—the matrix here containing no cell nuclei. Where the cartilage is wanting, or its remnants are quite detached, the sclerotic bone beneath presents a certain number of areas extending from the calcified zone, and distinguished from the proper osseous substance by their staining of a faint violet colour, and being quite homogeneous in structure: the proper bone being stained red with the eosin. In certain spots this homogeneous material is intimately mixed with the laminated structure of the bone, suggesting that it has arisen by a process of degeneration occurring in the latter. The cells in the degenerate areas are unstained or stained very faintly. Here and there the more superficial parts of the degenerate tissue contain groups of cells apparently cartilaginous. Slightly below one of the extensions of degenerate tissue is the small nodule of cartilage already described.

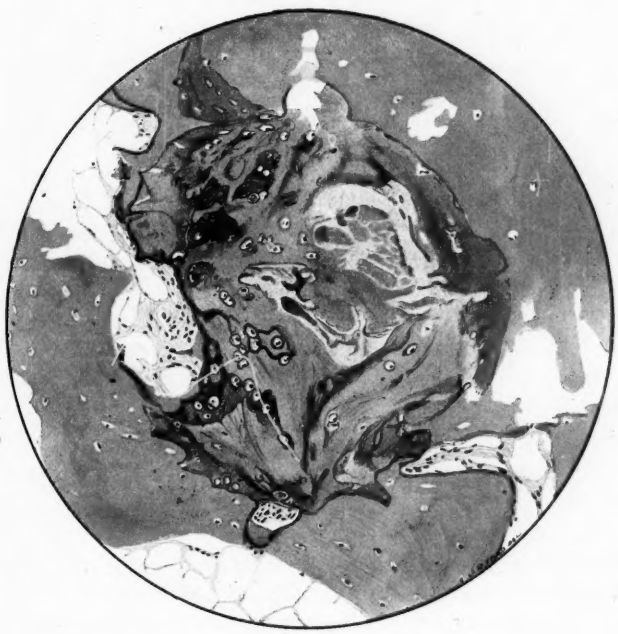


FIG. 85.—Cartilaginous nodule formed by metaplasia from bone, and itself undergoing cystic degeneration. (One-sixth obj.)

If this small cartilaginous focus be examined under a higher power (*Fig.* 85), the degenerate and more faintly staining osseous tissue may be seen above and to the right, and it is clear that the cartilage cells have arisen by a process of metaplasia from the bone corpuscles, and that the cartilaginous matrix has arisen from the bony matrix in a similar manner. The cause of the degeneration still continuing to act, the cartilage itself is undergoing degeneration in the centre.

The presence of cysts in the articular cartilage has already been noted; the synovial chondromata may also undergo cystic degeneration. We thus see that there are at least three topographical varieties of cyst in osteo-arthritis. There is no evidence at present that cysts of the semilunar cartilages may own the same pathogenesis.

### *C.* CHANGES IN THE SYNOVIAL MEMBRANE.

In a very large proportion of cases, the first naked-eye appearance of the disease occurs in the central area of the articular cartilage, and the synovial membrane very rarely shows any obvious changes until the first sign of 'lipping' appears. It will then be noted that at these spots the membrane is thickened, and there is enlargement of the existing, with formation of new, villous processes.

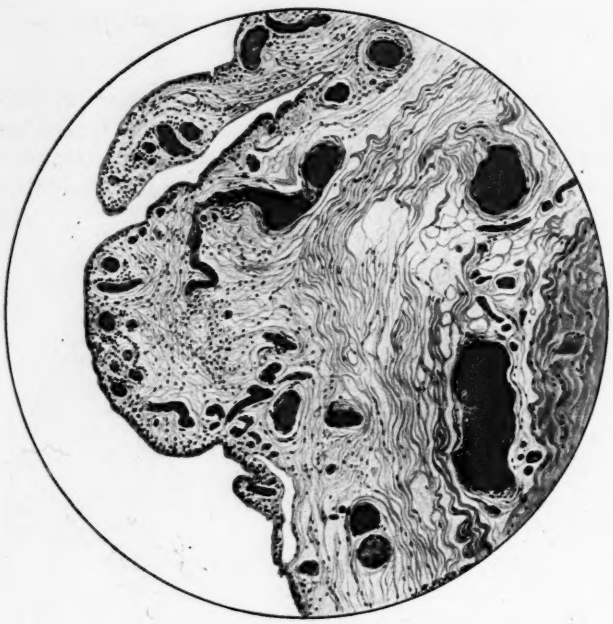


FIG. 86.—Mr. Couzens' case. Vascularity of the synovial membrane in osteo-arthritic knee-joint such as is usually met with in the disease. The patulous vessels are represented in colour. (Two-thirds obj.)

These changes may be quite local in the early stages. When examined during life at operation, the affected portion of the synovial membrane appears unduly vascular. Microscopical examination of the membrane in all save the very advanced cases shows that there is a general hyperplasia affecting all its elements, and that the membrane and the newly-formed villi are well supplied with blood-vessels—the arterioles and capillaries being perfectly patent and showing no signs of arteriosclerosis (*Fig.* 86). Specimens injected with carmine and gelatin demonstrate well that the membrane is not in a state of diminished vascularity.

In certain cases, as is well known, the enlarged villi become the seats of a formation of adipose tissue (lipoma arborescens of Müller). *Fig.* 87 represents a good example of this condition from St. George's Hospital Museum.

A further remarkable change is the formation of nodules of cartilage in the synovial villi. I have discussed these interesting tumours elsewhere and have named them 'synovial chondromata'. In the later stages of osteo-arthritis the hypertrophied synovial villi undergo secondary changes, and the membrane becomes comparatively smooth and atrophic. In this late stage arteriosclerotic changes may sometimes be observed in the vessels of the capsule and membrane. These have been noted in one case by Hoffa and Wollenberg and more recently by Strangeways. Since, however, these vascular changes, if they occur at all, occur late in the disease, it is difficult to see how they can constitute an etiological factor, as these observers state.

*Fig.* 88 shows some of the features of the later stages. The section from near the edge of the trochlear surface shows elongation of the fringes which are fibrotic, the tissue almost as far as the endothelium being dense and somewhat homogeneous. Most of the capillaries are patent in the fibrotic areas, although the fibre immediately around them is arranged somewhat conformably with the lumen. In other fringes the concentric arrangement of fibres around the capillaries obtains without any surrounding fibrosis. This striking development of fibres round the capillaries might well be termed 'peri-capillaritis diffusa'. None of the fringes contains any fat. In a few spots the capillary is blocked by an associated proliferation of endothelium.

The gross changes in the capsule and intra-articular structures are too well known to require separate consideration.

Suppuration, as was originally pointed out by Sir Benjamin Brodie, is a very rare complication of osteo-arthritis. A probable explanation of this fact will be adduced below.

FIG. 87.—Lipoma arborescens. (III, 4, 3. St. George's Hospital Museum.)

FIG. 88.—Synovial membrane showing peri-capillaritis diffusa. (692, 4. St. Bart.'s Hospital Museum.)

## ETIOLOGY AND ITS RELATION TO PATHOLOGICAL DEDUCTIONS.

Space will not allow a detailed consideration of the difficult problem of the etiology of osteo-arthritis, and necessitates a summary of main conclusions. A more complete analysis of these will be given elsewhere.

I may perhaps venture to give the following definition that I have formulated: "Osteo-arthritis does not constitute a disease *sui generis*, but rather the series of physiological or pathological changes that occurs in a joint when it is subjected to prolonged or oft-repeated injury either mechanical or toxic, but of a moderate degree of intensity." The causes are therefore very varied, and there can be little doubt that the future will bring to light additional factors in its causation of which we are at present ignorant. Osteo-arthritic changes, for example, occur with greater frequency in certain disorders of the ductless glands, such as acromegaly, than in my opinion can be ascribed to mere

coincidence. Whether in these cases the joint changes are due to the action of toxins formed from failure of the ductless gland to supply the necessary link in the chain of metabolic endogenous products, or whether in some way the resistance of the joint to bacterial toxins is lowered, it is impossible at present to state.

The relation of osteo-arthritis to the group of auto-intoxications due to defects in the excretory apparatus or the accumulation in the body of products of normal metabolism is still undecided. In spite of these undecided factors, there emerge two groups concerning the etiology of which we have a little more evidence. The following preliminary classification is therefore adopted : (*A*) *Traumatic osteo-arthritis*; (*B*) *Osteo-arthritis due to bacterial toxins which are* (*a*) *formed locally*, (*b*) *brought from some distant focus.*

FIG. 89.—Osteo-arthritis and fracture-dislocation of external semilunar cartilage; a loose body of the 'classical' type is also present in upper part of joint. (709A. Middlesex Hospital Museum.)

*Group A.* **Traumatic or Localized Osteo-arthritis.**—Examples of this large group occur very frequently, and have, moreover, considerable medico-legal importance. In many cases it is difficult to be certain whether we are dealing with a case of true traumatic osteo-arthritis, or whether the injury has lowered the resistance of the joint structures and caused the latter to become the site of action of bacterial toxins. It must not be forgotten that, although articular cartilage is devoid of vessels, yet it exhibits the cellular response which constitutes one of the principal phenomena of inflammation, and that the latter may be brought about by mechanical injury quite apart from the action of toxins. True traumatic osteo-arthritis is usually distinguished by the fact that the pathological changes are in most cases localized for a considerable period to that part of the joint which is subjected to the greatest degree of mechanical trauma. Moreover, an important etiological factor lies in the fact that the traumata are oft-repeated and spread over a long period of time. Clinical and experimental observations cause me to doubt whether an isolated contusion of a joint is in itself sufficient to cause true traumatic osteo-arthritis, although it may undoubtedly be a predisposing factor.

*Classification of traumatic osteo-arthritis.*—Among the causes may be enumerated :—

1. The presence within the joint of a loose body or other localized source of irritation.
2. Fractures involving joint surfaces or of the adjacent bone that bring about altered alinement of these.
3. Altered articular alinement from disease of the limb bones with consequent deformity.
4. Localized increase of articular stress of an occupational origin (Arbuthnot Lane).
5. Osteo-arthritis in false joints.
6. Abnormal joint mobility, from rupture or stretching of capsular or intra-articular ligaments.
7. The repeated intra-articular hæmorrhages of hæmophilia.

Examples of these varieties are of frequent occurrence, and space does not permit their detailed discussion. It can hardly be sufficiently emphasized, however, that in many cases the occurrence of the traumatic form is evidence of improper or neglected treatment.

*Fig.* 89 represents a knee-joint from the Bland-Sutton Institute of Pathology of the Middlesex Hospital. A loose body of the traumatic type derived from the articular surface of the patella, which was fractured some years previously, lies immediately above the outer part of the trochlear surface of the femur. Secondly, there is a marked displacement forwards of the posterior end of the external semilunar cartilage which has become twisted and adherent to the anterior end. The osteo-arthritic changes are largely confined to the outer part of the joint. It is not uncommon to find changes in the articular cartilage, consisting in fibrillation, erosion, or nodular eminences beneath an abnormally mobile or damaged semilunar cartilage of long standing.

FIG. 90.—Early osteo-arthritic changes in knee-joint from case of hæmophilia. (740C. St. Bart's Hospital Museum.)

FIG. 91.—Osteo-arthritis occurring after several attacks of acute rheumatism. (4513. Guy's Hospital Museum.)

These changes are to be distinguished carefully from those arising after operations on the semilunar cartilages in which, either from division of the internal lateral ligament or faulty after-treatment, a condition of abnormal joint mobility has arisen. Clinical and experimental experience convinces me that when loose bodies in joints are smooth, encapsulated, or situated in some part of the joint where they are unable to damage the articular cartilage, osteo-arthritic changes are unlikely to occur.

The following experiment demonstrates the latter points :—

*Experiment* 10.—The right knee-joint of a rabbit was opened by a vertical incision on the inner side, and a small pellet of sterile wool was inserted into the supra patellar pouch. In addition, three small sterile leaden shot were introduced. The wound was sutured in two layers and a collodion dressing applied.

The after-history was quite uneventful; the animal used the limb normally and there was no limp. Seventeen weeks later, on opening the joint, it was seen that the pellet of wool which had remained in the supra patellar pouch was surrounded by a smooth and glistening sheath of connective tissue. The leaden shot were lying perfectly free and unaltered in the lower and front part of the joint. Careful examination failed to reveal any fibrillation or other abnormal changes in the articular cartilage. This specimen is now in the Museum of the Royal College of Surgeons.

When a traumatic loose body (i.e., a detached portion of the articular surface) is quite free, it occasionally gives rise to generalized osteo-arthritic changes. These are preceded by oft-repeated attacks of synovitis, and the articular cartilage participates in the inflammatory reaction caused by the loose body becoming caught between the articular surfaces. In some cases these osteo-arthritic changes are associated with the formation of synovial chondromata, and I have observed the association in the same joint of a traumatic loose body and of detached synovial chondromata.

*Fig.* 90 (*Specimen* 740c. St. Bart's Hosp. Museum) shows early osteo-arthritic changes in the left knee-joint from a fatal case of hæmophilia—a boy, age 13. At the under surface of the external condyle of the femur fibrillation and wearing away of the cartilage have occurred. Similar changes are also present in the articular surface of the patella, and the synovial membrane is markedly stained. In the right knee (not figured) the changes are far more advanced, and osteophytes are present. There can be little doubt that these changes in hæmophilic joints are directly due to the mechanical irritation of the articular cartilage by blood.

*Group B.* **Osteo-arthritis due to Bacterial Toxins.**—

*a.* Osteo-arthritis occurring in the more chronic forms of the so-called specific infections, such as typhoid fever, pneumonia, dysentery, gonorrhœa, syphilis, etc.

My personal observations confirm those made by most other workers, that in these chronic joint affections it is rarely possible to isolate organisms from the joint fluid. However, it is illogical to argue from this that the joint affections are unconnected with the organism which has given rise to an existing or recent infection.

Two alternative explanations of this absence of organisms from the joint fluid may be given: (1) The specialized synovial cells which are disposed in many layers, particularly near the articular margins, form a barrier effectually shutting off organisms from the joint cavity, save in the more acute cases. The toxins elaborated by these organisms gain access, however, to the synovial fluid. (2) The bacterial toxins are brought to the joint from some distant focus. This appears the more likely hypothesis in most cases; the reason for this view will be adduced later.

As an example of the subdivision under consideration may be cited the occurrence of osteo-arthritis after acute rheumatism.

*Fig.* 91 (*Specimen* 4513 Guy's Hosp. Path. Museum) depicts a knee-joint from a case of rheumatism, and shows both acute and chronic disease. The articular cartilage is fibrillated and softer than normal, and in addition there is some ulceration of the articular cartilage of the femur and patella. The margins of the condyles are slightly lipped. The synovial membrane is thickened and covered with polypoid outgrowths. The ulceration of the cartilage is probably of recent date, and the fibrillation, synovial overgrowth, and lipping are osteo-arthritic changes caused by repeated attacks of acute rheumatism. It is from a woman, age 25, who was admitted for acute rheumatism and died in the hospital. At the autopsy, both knees were found to contain opalescent fluid in which were masses of fibrin. Myocarditis and valvular disease of the heart were present.

In this connection it is of interest to note that Poynton and Paine and Beattie have produced osteo-arthritic lesions experimentally with organisms isolated from cases of rheumatism.

*b.* The so-called 'idiopathic', 'spontaneous', or 'senile' osteo-arthritis.

This type is extremely common in persons who have passed the meridian of life, and cases abound in every out-patient department. There is a school which ascribes such forms of osteo-arthritis occurring in elderly persons to the so-called 'senile degeneration' (*vide* the term 'degenerative arthritis'). Hoffa and Wollenberg have suggested that the changes might be due to deficient nutrition of the joint structures brought about by endarteritis obliterans of the nutrient vessels. More recently, Strangeways of Cambridge has advanced the theory that the changes are due to alteration in the nutritive value of the synovial fluid, which is brought about by arteriosclerosis of the vessels of the joint capsule.

DEDUCTIONS TO BE DRAWN AS TO THE ETIOLOGY OF THE 'IDIOPATHIC' OR 'SENILE' FORM OF OSTEO-ARTHRITIS FROM THE PATHOLOGICAL AND CLINICAL DATA, WITH AN ACCOUNT OF SOME EXPERIMENTAL OBSERVATIONS.

*a. Deductions from the Morbid Histology of the Affected Joints and from the Composition of the Synovial Fluid.*—

1. My analyses of synovial fluid from osteo-arthritic joints reveal the fact that it is actually richer in protein content than normal synovial fluid. Secondly, on the theory of altered nutrition by the synovial fluid, the changes should take place in those parts of the cartilage most remote from its access, whereas the reverse is the case.

2. Although the ground substance of the articular cartilage, particularly of the central area, certainly degenerates, yet the cartilage cells usually show no sign of degeneration, and may actually proliferate. This proliferation is particularly well-marked in the lateral parts of the articular cartilage, where chondro-osteophytes, often of large size, may be formed. This proliferation is *difficult to reconcile with the theories of senile degeneration or of diminished nutrition.*

3. The changes in the bone are at first hyperplastic, and it is only at a later period that the newly-formed bone becomes atrophic, and its cancellous spaces of open and fatty texture.

4. The changes in the synovial membrane are at first *hyperplastic rather than degenerative.* The marked increase of synovial villi, with formation in some cases of synovial chondromata, is extremely difficult to reconcile with any form of senile degeneration.

5. The synovial membrane in all the earlier cases examined was found to be highly vascular: the larger vessels and capillaries being patent and presenting no sign of endarteritis obliterans. There is evidence, however, that in the later stages some endarteritis may be present, and the synovial membrane admittedly becomes atrophic.

6. The joint changes bear no constant relation to age. Similar pathological appearances may occur in middle-aged or young individuals, in whom these 'senile' changes may be very marked. Furthermore, in very aged individuals the lesions of osteo-arthritis may be absent.

7. The conclusion to be drawn from the morbid histology strongly favours the view that the joint structures *are acted upon by toxic substances,* which, in the poorly-nourished central area of the articular cartilage, bring about degeneration of the ground substance, and elsewhere proliferation. The latter process is followed later by degeneration from the continued action of the toxin. The anatomical position of the lesions strongly suggests that the circulus articuli vasculosus is the principal vascular route through which the toxins reach the joint.

8. The usual absence of small-cell infiltration in the various joint structures and of micro-organisms in the synovial fluid suggests that the toxic substances are not formed by bacteria *in situ* but are brought from some other part of the body.

*b. Deductions upon the Possible Origin of the Toxic Substances from the General Pathological Appearances as Revealed Post Mortem.*—It was thought that a number of investigations of the general pathological appearances might throw some light upon the source of the toxic substances. In this part of the research it is my pleasant duty to acknowledge the help and facilities accorded me by Sir Frederick Andrewes and Dr. Spilsbury.

From the subjoined tables it will be seen that:—

Out of seventeen cases in *Table I* (slight osteo-arthritis), potential foci of infection were present in fifteen.

Out of six cases in *Table II* (moderate degree of osteo-arthritis), in four there were distinct foci of potential infection, and in two the evidence points to intestinal toxæmia. In all six cases well-marked co-existent lesions of an infective or toxic nature were present.

Out of three cases in *Table III* (advanced osteo-arthritis), in two, potential

infective foci were present, and in all three various co-existent lesions—probably of infective or toxic origin.

We thus see that the evidence derived from the general post-mortem pathological appearances in cases of osteo-arthritis certainly lends support to the theory that the disease may be caused by the action, amongst others, of toxic substances elaborated in chronic infective foci. It should be added that, since it is not usual to pay particular attention to the teeth, gums, tonsils, or accessory nasal sinuses in ordinary post-mortem examinations, these possible sources of toxic absorption must be ruled out of count in the subjoined table. Moreover, intestinal toxæmia may be present without any very striking naked-eye pathological changes. It is therefore possible that many of the potential infective foci found were themselves secondary to intestinal infection.

*Table I.*—Slight Osteo-arthritis.

| No. | Sex | Age | Cause of Death | Potential Infective Focus or Foci | Co-existent Lesions, probably of Infective or Toxic Nature |
|---|---|---|---|---|---|
| 1 | M | 67 | Cerebral embolism | Chronic empyema Evidence of old ulceration of stomach | Atheroma of coronary arteries. Fibrosis of pancreas |
| 2 | M | 50 | Fracture of base of skull | Tuberculous foci both lungs | Cirrhosis of liver and kidneys |
| 3 | M | 75 | Strangulated inguinal hernia | ? Intestinal toxæmia | Granular kidneys; patches of atheroma of aorta |
| 4 | M | 56 | General peritonitis | Chronic cholecystitis with biliary calculus | Cirrhotic liver, granular kidneys |
| 5 | M | 56 | Lobar pneumonia | ? Intestinal toxæmia | Chronic pancreatitis |
| 6 | M | 58 | Arteriosclerosis | Gastric ulcer | Cirrhotic liver and granular kidneys; atheroma of aorta |
| 7 | M | 57 | Aneurysm of aortic arch | Syphilitic infection | Syphilitic aortitis; arteriosclerosis |
| 8 | M | 67 | Pernicious anæmia | Superficial ulceration of large bowel. ? Intestinal toxæmia | Usual signs plus thickening of coronary arteries. |
| 9 | M | 48 | Carcinoma of stomach | Toxic absorption from growth | No general P.M. performed |
| 10 | M | 47 | Perforated gastric ulcer | Large chronic ulcer of stomach | No general P.M. performed |
| 11 | M | 28 | Infective endocarditis | | Chronic parenchymatous nephritis, mitral and aortic endocarditis, infarcts spleen and kidney, etc. |
| 12 | M | 66 | Carcinoma of the œsophagus | Toxic absorption from growth | No general P.M. performed |
| 13 | F | 34 | Carcinoma of stomach | Toxic absorption from growth | Kidneys congested, with cloudy swelling |
| 14 | M | 40 | Pulmonary neoplasm | Toxic absorption from growth | No general P.M. performed |
| 15 | F | 39 | Lobar pneumonia | Chronic bronchiectasis right lung | No general P.M. performed |
| 16 | M | 39 | Carcinoma of stomach | Toxic absorption from growth | No general P.M. performed |
| 17 | F | 46 | Septicæmia | Suppurative arthritis left shoulder | Lungs congested and œdematous |

*Table II.*—Moderate Degree of Osteo-arthritis.

| No. | Sex | Age | Cause of Death | Potential Infective Focus | Co-existent Lesions, probably of Infective or Toxic Nature |
|---|---|---|---|---|---|
| 1 | M | 59 | Phthisis | Both lungs full of abscesses | Atheroma of coronary arteries and aorta |
| 2 | M | 57 | Cirrhosis of liver | ? Intestinal tract | Cirrhosis of liver and pancreas |
| 3 | F | 49 | Uræmia | Chronic suppuration in accessory sinuses | Kidneys sclerotic. Old perisplenitis. Tricuspid and mitral valves thickened |
| 4 | F | 66 | Cholelithiasis | Biliary tract | Pancreatitis. Abundant growth of *B. coli* from urine |
| 5 | F | 48 | Septicæmia | Wide-spread chronic dermatitis | Cloudy swelling of kidneys. Fatty degeneration heart and liver |
| 6 | M | 51 | Carcinoma of head of pancreas | ? Intestinal tract | Remainder of pancreas hard and fibrotic—obstructive biliary cirrhosis |

*Table III.*—Advanced Osteo-arthritis.

| No. | Sex | Age | Cause of Death | Potential Infective Focus | Co-existent Lesions, probably of Infective or Toxic Nature |
|---|---|---|---|---|---|
| 1 | M | 68 | Cerebral hæmorrhage | — | Atheroma of cerebral, renal, and coronary arteries, and of aorta |
| 2 | M | 65 | Fractured base | Chronic cholecystitis | Vegetations on aortic valves. Atheroma of aorta. Evidence of old peritonitis |
| 3 | M | 49 | Uræmia | Chronic cystitis. Suppuration in prostate | Interstitial nephritis. Atheroma of aorta |

The frequency with which atheroma and arteriosclerosis were present in the above series is of great interest, and suggests that they have the same cause as the osteo-arthritic changes. Furthermore, as a general rule it was found that the degree of osteo-arthritis present was proportionate to the extent of the arteriosclerotic changes. The theory that arteriosclerosis is primarily inflammatory rather than degenerative we owe to Virchow; and the evidence in favour of his view is strong, although, as in osteo-arthritis, there is an absence of small-cell infiltration. It is probable that old age is a factor, as in osteo-arthritis, only through virtue of the fact that it allows time for chronic bacterial infection gradually to break down local powers of resistance.

*c. Deductions from Clinical Data.*—Space will not permit the enumeration of case-histories, but compels me to summarize my conclusions from a critical study and analysis of a large number of hospital and private patients. In at least 95 per cent of cases of osteo-arthritis I have been able to satisfy myself that a definite focus or foci of toxic absorption were present.

I am unable to find records of a single case where treatment directed towards the focus or foci in question has not produced amelioration of the joint condition, and in many cases cure has resulted. A careful analysis of my personal cases and of cases published by other investigators—including those of Sir Arbuthnot Lane* and Sir Kenneth Goadby

* I am indebted to Sir Arbuthnot Lane and to Dr. Mutch for kind help in this aspect of the research.

—convinces me that the arthritis on the clinical evidence must be considered as the result of the infective condition, and that this co-existence and the effects of treatment cannot be dismissed by any rational person as a mere fortuitous coincidence.

The possible foci of toxic absorption are very numerous; and my experiments upon animals led me to believe that the joint resistance is gradually broken down. It is this prolonged resistance of the joint which probably accounts for the fact that osteo-arthritis is more common in those past the meridian of life.

*d. Deductions from Experimental Observations.*—It is obvious that if we are able to produce osteo-arthritis experimentally by bacterial toxins, and particularly if the bacteria are obtained from an obvious focus of infection in a patient suffering from osteo-arthritis, this evidence must lend strong support to the theory of causation of the latter by bacterial toxins.

The following typical experiment of mine may be quoted :—

*Experiment* 11—The *Streptococcus salivarius* was isolated by Dr. Standish from the teeth sockets of a male patient, age 65, with marked pyorrhœa alveolaris, who also had osteo-arthritis of the left hip. A broth culture of the organism was prepared. Of this culture 1 c.c. was injected into the right knee, and half this quantity into the left knee, of a rabbit. The left knee had been previously subjected to percussion for two minutes with a mallet. Six weeks later the animal was killed. The left knee (which it is to be noted had received only half the amount of organisms received by the right, but which had been subjected to percussion) was filled with thick creamy pus, the synovial membrane was converted into granulation tissue, and some absorption of the articular cartilage had occurred. No true osteophytes were present. The right knee-joint presented unequivocal signs of osteo-arthritis.

This experiment demonstrates also the important part which trauma may play in lowering the resistance of the joint to infection, and affords some explanation of the frequency with which the onset of osteo-arthritis is preceded by trauma.

As is well known, the joint fluid in osteo-arthritis is, in a very large proportion of cases, sterile. I have, however, found that this sterile fluid when injected into the joints of rabbits induces degenerative changes in the articular cartilage; thus demonstrating that the fluid from osteo-arthritic joints *contains toxic substances.*

*Experiment* 12.—From the knee-joint of a case of early osteo-arthritis with effusion, 2 c.c. of sterile synovial fluid were injected into the right knee-joint of a rabbit, and 1·5 c.c. into the left. Six days later it was noted that the temperature was raised over both joints, and some limitation of flexion was present from muscular spasm. This, however, soon disappeared, and the joints appeared normal. Four months later, however, on examination the joints showed well-marked superficial erosion of the articular cartilage at the junction of the trochlear and condylar portions of the articular surface.

The following experiment was performed to ascertain the reaction of the joint to metabolic poisons formed in the intestinal canal upon the organic constituents of the intestinal contents. In the bowel tyrosin is first changed to highly poisonous hydroxyphenylethylamine (tyramine acid phosphate) and ultimately to the relatively innocuous phenol.

Similarly β-iminazolylethylamine (histamine phosphate) is formed from histidin.

*Experiment* 13.—Into the right knee-joint of a rabbit 0·5 grm. of histamine phosphate dissolved in 1 c.c. of sterile water was injected, and 0·227 grm. of tyramine acid phosphate in a similar quantity of sterile water was injected into the left knee-joint. It should be noted that 0·001 grm. hypodermically is the human dose of the former and 0·02 grm. of the latter.

No reaction of any kind occurred in the joints, nor was any constitutional reaction observed.

**Osteo-arthritis Occurring in Diseases of the Central System, such as Tabes and Syringomyelia.**—As is well known, in these diseases the joints may be the seat of pathological changes, which, save that all the processes tend eventually to become exaggerated, are, as Sir Frederick Eve pointed out, similar in all respects to those occurring in osteo-arthritis. It seems highly probable that the osteo-arthritic changes are not due directly

to the disease of the central nervous system, but that the latter in some way leads to the increased rapidity and extent of these changes.

**Osteo-arthritis Occurring in Chronic Gout.**—Microscopical examination of the articular cartilage in gout does not lend support to the view that the osteo-arthritic changes are due to the irritation induced by the presence of crystals of sodium biurate, for there is very little proliferation of the cartilage cells in their vicinity: we are not thus faced with a form of traumatic osteo-arthritis. The actual etiology of gout is still unsettled, but on the analogy of the types of osteo-arthritis already passed under consideration, it would appear that the joint changes occurring in the chronic form of the disease are brought about by the action of bacterial toxins.

## SYMPTOMATOLOGY AND DIAGNOSIS.

Although, as we have already noted, osteo-arthritis, particularly when of the traumatic and infective types, may occur in young persons, yet the subjects it selects are usually middle-aged or elderly. In my experience males are slightly more liable to the condition than females. The traumatic form usually, but not invariably, affects a single joint, whereas the infective or toxic form may be uni- or polyarticular. The latter variety commonly commences in the hands and feet, where the terminal interphalangeal joints are usually first affected, often with formation of Heberden's nodes. The onset is usually slow, insidious, progressive, and unassociated with raised temperature or marked constitutional symptoms. Aching in one or more joints after use, often associated with a slight degree of swelling, is generally the first symptom. The pain and swelling gradually increase, and if examined at the early stage it is often possible to find slight increase of temperature over the joint and a little painful limitation of movement by muscular spasm. The presence of fluid may not infrequently be detected; and in certain cases fluid may be present in marked quantity, not only in the joint itself, but in bursæ communicating therewith, and occasionally in bursæ and tendon sheaths quite unconnected with the joint cavity. In a series of investigations of the synovial fluid from these cases, in which Dr. Arthur Davies, pathologist to the Dreadnought Hospital, Greenwich, has rendered invaluable assistance, we have not succeeded in discovering the presence of bacteria; but from the observations already made, too much weight must not be placed upon this negative evidence. The fluid, as has been stated, is rich in albumin, and differs thus markedly from normal synovial fluid.

In some cases a somewhat rapid effusion of fluid may form the first sign of the disease. This early heat, pain, and fluid effusion appear to point strongly to the inflammatory, rather than to the degenerative, origin of osteo-arthritis.

The aching and pain in the joint after use are rarely sufficient to prevent the patient from following his occupation in the early stages. Stiffness after rest, and particularly first thing in the morning, become marked features, although this symptom in itself rarely causes the patient to seek relief. Thickening of the synovial membrane or capsule is not a marked feature at this stage. After a variable period, lipping of the articular margin may be distinctly felt; the earliest lipping, as it consists of cartilage only, may not be apparent on *x*-ray examination. The synovial membrane can now be felt to be thickened, particularly round the patella and trochlear surface of the femur, and loose bodies such as chondromata growing therefrom may be detected. There is 'snowball crunching' crepitus on movement from the mutual apposition of thickened synovial fringes.

In the later stages, when the articular cartilage over the central area has been worn away and the bone has become exposed, pain becomes a more marked feature. The patient often complains of a constant 'gnawing pain' as if the 'bones are grinding together', as indeed they are. The constant pain, worse on exercise, is often of such an exhausting nature that a patient may rapidly lose weight, become markedly neurasthenic, and his existence be sadly embittered; on the other hand, symptoms may be remarkably slight. At this stage osteophytic outgrowths may be very marked, and there is usually

harsh grating on movement (although when eburnation occurs movement becomes smoother), associated with shortening, lateral mobility, and various kinds of deformity. At this stage there is usually an absence of fluid in the joint ('arthrite sèche').

The rarefaction, which, as we have already described, occurs in the cancellous tissue of the articular extremities, shows up in a conspicuous manner on *x*-ray examination, which may reveal pseudo-cystic spaces traversed by attenuated bony trabeculæ.

**Differential Diagnosis from Rheumatoid Arthritis.**—In rheumatoid arthritis we have the clinical and pathological picture of a more marked inflammatory process than is the case in osteo-arthritis. This inflammatory process brings about a reflex muscular spasm which tends in the more acute types to cause a considerable degree of limitation of joint movement. Owing to the immobility of the joint, no obstacle is placed in the way of the outgrowth of a synovial pannus which gradually extends over the surface of the articular cartilage. There can be little doubt that the vitality of the cartilage is seriously interfered with through the action of toxins, and that the advancing synovial pannus of granulation tissue serves the purpose of replacing the degenerate cartilage. It is easy to see that the end-result of this process is usually intra-articular ankylosis.

In the more chronic process of osteo-arthritis muscular spasm is slight or absent, and the continued movements prevent the pannus of granulation tissue from the synovial membrane from encroaching upon the surface of the articular cartilage, just as the movements of the fœtus before birth gradually disperse the connective tissue covering the articular cartilage; true intra-articular ankylosis therefore occurs rarely, if ever.

In rheumatoid arthritis, the swelling of the synovial membrane and capsule is more marked, and causes the typical spindle-shaped swelling of the joint. The disease occurs more commonly in women between the ages of 20 and 40, and usually several joints are affected. Every stage of acuteness may be seen, and constitutional symptoms are often present, such as anæmia and wasting, also vasomotor changes such as sweating, coldness and glossiness of the hands or feet, or tingling, numbness, and a sensation of pins and needles in the same situations. Associated enlargement of lymphatic glands and spleen may occur in children (Still's disease), and not infrequently this glandular enlargement may be detected in adults. The prolonged muscular spasm causes atrophy of the tissues surrounding the joints, including the skin, hence the name 'atrophic' which is sometimes given to the disease or group of diseases.

## TREATMENT.*

In the traumatic group, prevention is naturally better than cure, and in many cases the occurrence of this variety is due to faulty treatment. However, as this form is usually localized, appropriate treatment of the deformity or other source of irritation where practicable may stop the progress of the disease.

I would adduce the following general principles of treatment, which are particularly applicable to the earlier and active stages of the disease, and for the infective or toxic group, including the 'senile' variety:—

(1) *Eradication, as far as possible, of any focus or foci of toxic absorption, including measures that prevent the formation or assist the elimination of systemic toxins.* (2) *The cessation, particularly in uni-articular cases and in the lower extremity, of pressure between diseased articular surfaces.* (3) *Local treatment to the joints themselves to stimulate defensive reaction of articular elements, and to prevent ankylosis.* (4) *Dietetic and medicinal treatment.*

It is desired to emphasize strongly that it is in the early stages, before serious structural changes have occurred in the affected joints, that treatment is often of great benefit and cure may result. The pessimistic or *laissez-faire* attitude prevalent concerning the treatment of osteo-arthritis appears to be unjustified, and exists because, from ignorance of the cause, the joints have been allowed to drift to advanced structural change.

---

* I am indebted to Sir Robert Jones for kind suggestions in the preparation of this section.

1. **The Eradication of Foci of Toxic Absorption.**—The possible foci of toxic absorption are very numerous, and several may co-exist. A careful and exhaustive examination of the whole patient is necessary in every case, and should particularly include the accessory sinuses and the whole of the alimentary, respiratory, and genito-urinary systems.

Co-operation in this search between surgeon, physician, and bacteriologist is absolutely essential, and it is this lack of co-operation that is responsible for so many failures.

In my series of cases of osteo-arthritis, failure to discover such foci of toxic absorption or evidence of their previous existence, was rare. In many cases the adherence to this principle combined with vigorous local treatment has led to cure. Although I attach importance to the presence of pyorrhœa alveolaris, yet it appears probable that in most cases the condition is associated with bacterial infection of other parts of the intestinal tract by organisms, particularly streptococci, which have escaped destruction by the gastric juice.

In some of these cases, as Sir Arbuthnot Lane and his co-workers have shown, intestinal stasis may be demonstrated, and in others the fæces contain pathogenic bacteria. It is my practice in all cases where marked pyorrhœa is present to investigate as fully as possible the condition of the whole alimentary tract. Toxic absorption from the latter constitutes the commonest mode of origin of osteo-arthritis. In women the uterus and its adnexa should always be investigated and inquiry made as to menstrual irregularities or the presence of discharge.

Simultaneously with treatment directed towards the eradication of foci of toxic absorption, the principle of treatment under discussion should include measures that assist the elimination of toxic substances by the skin, bowels, and kidneys, and the raising of the natural powers of resistance of the patient by every means within our reach. The latter may profitably include the use of autogenous vaccines.

2. **The Diminution of Intra-articular Pressure.**—*Rationale.*—The articular cartilage, one of the most important functions of which is to preserve the subarticular bone from friction, is being acted upon by toxic substances, and if subjected to pressure and friction, must become worn away. Furthermore, the cancellous bone is atrophic and unable to stand normal pressures. Every effort should therefore be made to diminish articular pressure, particularly in the lower extremity, in the early stages; and if the toxic focus is dealt with vigorously at this stage, a cure may sometimes be anticipated.

In cases with somewhat acute onset it is justifiable to immobilize the limb in plaster at first to attain this end, the joint being placed in the position which experience shows to be best should ankylosis occur.

In cases of average severity, the principle may be attained in the lower extremity by the wearing of a splint which prevents or minimizes intra-articular friction, but allows the patient to take a moderate amount of exercise, for this improves the general condition of the patient and tends to prevent muscular wasting. The exercise should be carefully supervised, as if carried to excess it may be harmful.

In the lower extremity the principle of extension or of diminution of intra-articular pressure by keeping the joint surfaces apart, combined with movement, although ideal theoretically, usually necessitates expensive apparatus, and it is doubtful whether the joint surfaces can be separated sufficiently without exercising strain upon the capsular ligaments and synovial membrane which are themselves often diseased. However, apart altogether from the question of combining extension with movement, there is no doubt that the wearing of a comfortable, light, and well-fitting support, such as a Thomas caliper splint or moulded leather support which keeps the joint in the position of greatest use to the patient, must markedly diminish intra-articular friction and usually brings about considerable relief. Pressure and friction are naturally less potent in the upper extremity, but the same principles may be applied.

By this combination of diminution of intra-articular friction and treatment of foci of toxic absorption, very marked improvement may be expected in early stages. Unfortunately, owing to the moderate severity of all the symptoms, the patient does not often

seek relief until grave structural changes have taken place in the joint. The problem of treatment is then a more difficult one and the results are by no means so satisfactory.

The principle of diminution of intra-articular friction and of weight-bearing in the lower extremity remains the same.

Broadly speaking, we may say that the principle may be achieved either by operative or non-operative measures, and that we may aim either at ankylosis or at the retention of a movable joint. The particular measures to be adopted depend on many different factors, and each case must be carefully considered on its own merits. A fairly firm extra-articular fibrous ankylosis may usually be attained by fixation in the optimum position by a splint. If we desire to retain movement, short of drastic measures, the method of combining extension with movement mentioned above may be adopted. Before a splint can be applied to bring this about, manipulations to stretch adhesions, tenotomies, and in some cases the chiselling away of obstructing osteophytes may be necessary. Even if it is decided to aim at ankylosis, these preliminaries may be necessary in order to obtain the best position. A large number of these cases are painful because of the presence of adhesions in the joint. If an anæsthetic is given and the adhesions are broken down, and if movements are practised aided by a masseur, an improved range of movement with alleviation of pain often ensues, and this improvement is maintained for a considerable time. These manipulations should always be performed by a qualified medical man, and never under any circumstances by the instrument maker. Experience shows this caution to be very necessary. When the splint is applied the patient no longer hesitates to walk through fear of pain, and his general condition may markedly improve.

There is reason to believe that if the toxic focus is properly dealt with the process of absorption may cease; the exposed bone, although it never becomes covered anew with articular cartilage, yet becomes sclerosed, hard, and polished; and a natural cure may be said to have occurred.

Operative measures are indicated in acute cases with severe pain, or in young or middle-aged persons in whom the disease appears to be no longer active, but has left a painful and deformed joint or one in which movement is limited. It is far too frequently overlooked that if a focus of toxic absorption exists, any benefit derived from operation must be of a temporary nature only, unless this is accompanied or preceded by a successful attack upon the focus.

The operative measures vary considerably, and every case should be carefully judged on its own merits, taking into consideration the patient's age, occupation, and general constitution. The results are sometimes disappointing, and this should be explained to the patient, whose personal desires, in addition, should be carefully considered. For example, the pros and cons of ankylosis or of an attempt to obtain a movable joint should be frankly discussed.

*Arthroplasty*, or the interposition of pedicled flaps of fascia or other substances between joint surfaces denuded of articular cartilage, is sometimes performed in the case of the hip, elbow, patellofemoral joint, etc. In certain cases marked improvement occurs, especially if any toxic focus is sought out and successfully treated, or the process has come to an end. Otherwise it would appear that the fascial flap must undergo the same fate as we have seen occurs to other intra-articular connective-tissue structures.

In a recent discussion on the treatment of osteo-arthritis of the hip-joint at a meeting of the British Orthopædic Association it was almost unanimously agreed that the operation of arthroplasty of this joint was disappointing in its after-results. In the light of the pathological data given above, the reason for this seems clear. Arthroplasty of the hip in no way diminishes weight-bearing, and it is the weight of the body transmitted through the atrophic articular ends of the bones that causes a continuance of the symptoms. The operation devised by Sir Robert Jones often proves very beneficial in old people who are unable to stand the shock associated with excision. It is quickly performed and gives rise to very little shock.

*Removal of Osteophytes.*—The ruthless chiselling away of osteophytes is to be deprecated, since we have seen that they are compensatory developments which often play a

useful rôle. The rare indications for removal of osteophytes are : (1) When they interfere with movement ; (2) When they cause severe pain by pressure on an adjacent nerve ; (3) When they are themselves subjected to painful pressure.

Handley's operation of cheilotomy is especially indicated in comparatively young persons whose symptoms are not acute, but in whom movement is markedly restricted by osteophytic formations, and who should be given the chance of a more movable joint, short of the more drastic measures of arthroplasty or excision. An important practical point to bear in mind in these cases is that there is usually adaptive shortening of the capsule and extra-articular structures, and removal of the osteophytes does not in itself, in my experience, usually restore full movement, although pain is markedly lessened.

*Excision* is particularly indicated in suitable cases where pain is very acute. It may be performed either to obtain fixation or movement. In the former case it must be remembered that although the cancellous tissue of the bony extremities is of very open and fatty texture, yet good union usually occurs.

Excision of the hip is rarely indicated in elderly persons, since the turning out of the head of the femur is associated with a considerable degree of shock.

In young or middle-aged persons the operation is indicated where pain is a marked symptom. In the past the operation has been perhaps somewhat unjustly condemned. If, however, proper after-treatment is adopted, and the toxic focus suitably treated, there appears to be no reason to expect in the new joint the instability and recurrence of the disease which has been often noted in the past.

*Arthrodesis.*—The results of this procedure, particularly in the case of the hip, have been somewhat disappointing owing to frequent failure to obtain union. I believe that the disappointing results can be largely explained on pathological grounds since, as we have seen, the subarticular layer of bone is sclerosed and does not therefore readily unite with the corresponding opposed layer. The turning out of the femoral head is associated with a considerable degree of shock, which in itself is a drawback of the operation, particularly in elderly people.

3. **Local Treatment of the Joints Themselves.**—It can hardly be sufficiently emphasized that, unless the first two principles are adhered to, no great or lasting benefit may be derived from local measures. The latter form a useful adjunct ; but used by themselves almost invariably lead to disappointment. Unfortunately, it is only too common to see cases that have tried every form of local therapy and have travelled from one hydrotherapeutic establishment to another, and during the whole period no attention has been paid to the first two all-important principles.

Radiant heat, electricity, local baths, ionization, massage, and movements both active and passive, are often of great value, since the stagnation of circulation that favours toxic action and inhibits the action of antibodies is prevented. Furthermore, in all cases of osteo-arthritis, unless we are definitely aiming at ankylosis, the joint or joints should be put through their full range of movement each day, for by this precaution ankylosis, deformity, and muscular wasting may be largely prevented and, in addition, interference with movement by osteophytes is thus avoided.

The faith of some in local measures cannot be better illustrated than by the fact that in a modern work on osteo-arthritis the first two principles that I have mentioned are ignored altogether, and the book ends with an appeal in support of the treatment at a well-known hydrotherapeutic establishment. The treatment recommended for bony nodes of the Heberden type is that they should be wrapped in lint soaked in a saturated solution of sodium chloride. The author naïvely remarks that the method must be used for a considerable time if good results are to be obtained.

4. **Dietetic and Medicinal Treatment.**—Some physicians lay considerable stress upon these factors. It is recommended by some that the carbohydrate and fatty constituents of the diet should be reduced in order to prevent an increase of the patient's weight. Malt liquors are excluded, although light wines—such as Moselle—in moderate

quantity are permitted. The rationale given for this treatment is that by reason of the presence of osteophytes the joint is in an 'extremely irritable condition', and that any addition to the body weight increases this irritability. However, there is no doubt that this treatment is based upon erroneous pathological views. Sufferers from osteo-arthritis are so apt to lose weight from the constant exhausting pain, that it seems desirable that the diet should be generous, strengthening, and digestible, and yet not of such a nature as to favour intestinal putrefaction.

With regard to medicine—guaiacum, sulphur, arsenic, and the iodides all have advocates.

In conclusion, it is my pleasant duty to express my thanks to those—too numerous to mention in detail—who have assisted in various ways in this research. Certain acknowledgements have already been made in the text. In particular, the work owes very much to the help and criticism of Professor Shattock, who honoured me by allowing the experimental work to be performed in his laboratory at St. Thomas's Hospital, and whose kindness, sympathy, and encouragement have been stimulating and inspiring. To Sir Arthur Keith I am indebted for much help and for granting me permission to work at the Royal College of Surgeons. The Medical Research Council have generously defrayed the expenses of the research by a grant from their funds. My colleagues at the Seamen's Hospital, Greenwich, particularly Professor Hewlett and Dr. Arthur Davies, have rendered valuable assistance. Finally, I must express my gratitude to the curators of many pathological museums and to Dr. Strangeways for the loan of specimens, also to Dr. Haward of the Ministry of Pensions, through whose help I have had special facilities for examining pensioners suffering from disabilities of the joints.

---

REFERENCES.

*Account of the Dissection of Morbid Bodies*, Hunterian MS. 70, No. 54.
ADAMS, *Chronic Rheumatic Arthritis*, Dublin, 1857.
BROCA, *Bull. Soc. Anatom.*, xxv, 435.
CHARCOT, "Lectures on Senile Diseases", *New Syd. Soc.*, 1881.
CHARCOT, *Thèse de Paris*, 1855.
CORNIL and RANVIER, *Histologie pathologique*, 1901–12.
CRUVEILHIER, *Anatomie pathologique*.
DEVILLE, *Bull. Soc. Anatom.*, xxii, 272, xxiii, 141.
EVE, Sir FREDERICK S., "Bones of Ancient Egyptians Showing Periostitis Associated with Osteo-arthritis", *Trans. Path. Soc.*, 1890, xli, 242.
FISHER, "A Study of Loose Bodies in Joints", *Brit. Jour. Surg.*, 1920–21, viii, No. 32, 493,
FOURTAU, R., "Contribution à l'Étude des Vertébrés miocènes de l'Egypte", *Geological Survey Department of Egypt*, 1920.
GARROD, Sir A. B., *Gout and Rheumatic Gout*, 1876.
GOLDTHWAIT, "Infectious Arthritis", *Boston Med. and Surg. Jour.*, 1904, cl, 363.
HAYGARTH, *Clinical History of the Nodosity of the Joints*, 1805.
HOFFA and WOLLENBERG, "*Arthritis Deformans und sogenannten chronischer Gelenkrheumatismus*", Stuttgart, 1908.
HUNTER, "Of the Structure and Diseases of Articular Cartilages", *Phil. Soc. Trans.*, xlii, 742.
LANE, ARBUTHNOT, *Path. Soc. Trans.*, 1884, xxxv, 229, xxxvi, 387.
NATHAN, *Amer. Jour. Med. Sci.*, 1906, Dec.
NICHOLS and RICHARDSON, *Arthritis Deformans*, Boston, 1910.
OGSTON, *Jour. Anat. and Physiol.*, 1876, x, 49, xii, 503.
REDFERN, "On the Healing of Wounds in Articular Cartilage", *Month. Jour. Med. Sci.*, 1851, xiii.
SMITH, G. ELLIOT, and JONES, F. WOOD, "Report on the Human Remains", *Arch. Survey of Nubia Report*, 1907–8, ii.
STRANGEWAYS, "Observations on the Nutrition of Articular Cartilage", *Brit. Med. Jour.*, 1920, May 15.
TESTUT, L., "Recherches anthropologiques sur le Squelette quaternaire de Chancelade Dordogne", *Ext. du Bull. de la Soc. d'Anthrop. de Lyon.*
TOYNBEE, "The Non-Vascularity of Certain Animal Tissues", *Phil. Trans.*, 1841, ii, 159.
VIDAL, *Thèse de Paris*, 1855.

# PHARYNGEAL DIVERTICULUM AND ITS SURGICAL TREATMENT, WITH A RECORD OF TWO CASES.

By D. P. D. WILKIE and J. N. J. HARTLEY, Edinburgh.

A pouch-like protrusion from the posterior wall of the lower part of the pharynx close to its junction with the œsophagus has been variously described as a 'pulsion diverticulum of the œsophagus', 'pharyngocele', 'pharyngo-œsophageal diverticulum', and '*grenz*[1] diverticulum'. Though it is usually stated that Mondière[2] was the first, in 1883, to describe the condition clearly, priority must certainly be claimed for Sir Charles Bell.[3] The latter, in 1816, recorded a case of difficulty in swallowing which was temporarily relieved by the passage of œsophageal bougies. The patient died from other causes than that associated with the throat, and, at the post-mortem, a posteromedian pouch was discovered. This astute observer not only pointed out its pharyngeal origin, but also tendered the explanation which, in the light of future experience, has proved the most plausible one. He assumed the sequence of events to be difficulty in swallowing due to a spasmodic contraction of the sphincter at the lower part of the pharynx, hypertrophy and fasciculation of the pharyngeal musculature, and finally herniation of the mucosa between hypertrophied muscle bundles of the inferior constrictor. He likened the condition to the hernial protrusion of mucosa which so frequently occurs in the hypertrophied bladder due to urethral obstruction. Credit is likewise due to Bell for being the first to suggest the possibility of alleviating such conditions, when associated with a swelling in the neck, by the establishment of a cervical fistula.

The next important contribution to the subject of pharyngeal and œsophageal pouches was that of Rokitansky,[4] who classified such pouches according to whether they originated primarily from pressure from within or traction from without, and hence the terms 'pulsion' and 'traction' diverticula. It is to the former of these that the pharyngeal diverticulum belongs. In 1877, Zenker,[5] in his classical study of 27 cases which came to post-mortem, laid a sure foundation for the symptomatology, diagnosis, and morbid anatomy of this condition. Though again subsequently overlooked, he further established clearly the pharyngeal origin of such pouches. It is of interest to recall his prediction with regard to the operative possibilities of the condition : " The radical cure of diverticula by surgical operation from without is at present one of our vain wishes, yet we are hopeful that even this operation, conducted on Lister's plan, may at some future day be performed without danger".

The first recorded operation was that by Nicoladoni[6] in 1876, when a fistula was established ; but the patient died on the sixth day from pneumonia. In 1890, von Bergmann[7] successfully excised a diverticulum, with, however, the formation of a temporary fistula. Kocher,[8] in 1892, performed the operation, with healing per primam. Since that time numerous cases submitted to operation have been recorded, and of late years—probably owing to modern methods of diagnosis—the numbers recorded have rapidly increased. Deis[9] has succeeded in collecting statistics of 149 operations. Butlin[10] in ten years operated on 8 cases, and in the Mayo Clinic[11] no fewer than 35 cases have been operated on.

**Pathological Anatomy.**—Though it had been shown clearly by Bell and Zenker that the site of origin was pharyngeal and not œsophageal, it was Killian[12] who first clearly established that the pouch is a protrusion of the mucous membrane between the transverse and oblique fibres of the cricopharyngeus muscle in the mid-line posteriorly (*Fig.* 92), and this has been abundantly confirmed by Goldmann,[12] Keith,[13] and others. As to the

pouch's increase in size, it descends and tends to be deflected to one side of the mid-line, usually to the left. It passes down behind the œsophagus and carotid sheath and lies between the prevertebral and pretracheal layers of cervical fascia, and may eventually occupy the posterior mediastinum. The sac is usually pyriform in shape, and its pharyngeal orifice is as a rule moderately wide. The sagging down of the sac very soon brings the pharynx into alinement with it, the upper extremity of the œsophagus appearing as a narrow aperture on the anterior border of the neck of the sac. This readily explains how all food and likewise how all instruments pass more readily into the diverticulum than into the œsophagus. The wall of the sac varies in thickness in different cases. So thin is it in some, that great care must be taken not to tear the wall (Bevan);[20] whilst in one of the cases here recorded, the wall when contracted measured 1 cm. (*Fig.* 97). Though variable in thickness, the constituents of the wall are remarkably constant. It is lined by stratified squamous epithelium, which in some cases shows hyperkeratosis, in others ulceration, and in a few this has gone on to malignant degeneration. In the submucous coat there may or may not be a muscularis mucosa, and this is in accord with the variability of the boundary of the œsophageal muscularis mucosæ. Around the neck of the proximal part of the sac are usually found loose fasciculi of striated muscle, arising from the inferior pharyngeal constrictor. The outermost coat, or tunica propria, is derived from the pharyngeal fascia, and it is this coat which largely determines the thickness of the wall. The loose areolar tissue which separates the tunica propria from the lining membrane gives to the diverticulum when grasped between the fingers the sensation experienced when one grasps the stomach. Moreover, this loose intervening layer provides a ready line of cleavage, and permits of submucous excision.

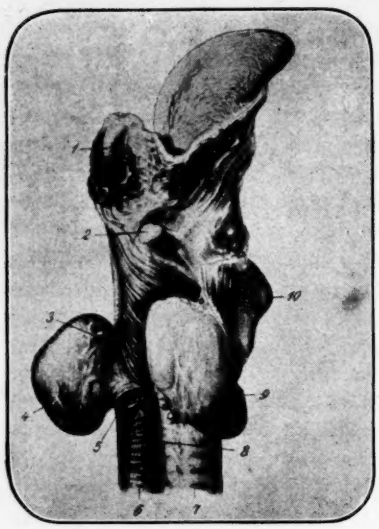



FIG. 92.—Pharyngeal pouch showing the relation of the neck to the two portions of the cricopharyngeus muscle (Killian). (*1*) Uvula; (*2*) Greater cornu of the hyoid bone; (*3*) Oblique portion of cricopharyngeus muscle; (*4*) Diverticulum; (*5*) Transverse portion of cricopharyngeus muscle; (*6*) Œsophagus; (*7*) Trachea; (*8*) Recurrent laryngeal nerve; (*9*) Thyroid gland; (*10*) Thyroid cartilage.

**Etiology.**—It may be stated at once that there is no evidence that the type of œsophageal diverticulum here described is ever congenital in origin. True, certain lateral diverticula and sinuses are attributable to defective closure of branchial clefts.[14] So far, however, no postero-median pouch has been met with in the new-born or in childhood. The majority of cases have occurred in male subjects past middle life, and, in a series of cases recorded by Stetton,[15] the average age was 54. In 27 cases recorded by Zenker, there was no female, and in the Mayo series of 35, the ratio of male to female was four to one.

The diverticulum is essentially a herniation of the mucosa through the musculature of the pharynx. One or both of two factors must operate—one, an abnormal increase of intrapharyngeal tension; the other, some localized weakness in the posterior pharyngeal wall. A weakness in the posterior pharyngeal wall has been described at a point where the longitudinal fibres of the œsophagus diverge, the so-called Lainer-Hackermann[16] triangle. But it has already been stated that the protrusion begins at a point between the oblique and transverse portions of the cricopharyngeus muscle. Though a congenital weakness at this point is conceivable, there is no proof of such existing. Probably far more important is the factor of prolonged abnormal intrapharyngeal tension. The second stage of normal deglutition, though initiated by volition, is chiefly an involuntary and complex reflex action. The oropharynx and nasopharynx are closed off, respiration is inhibited, and the larynx is suddenly drawn upwards and forwards, the bolus passing downwards and backwards towards the lower pharyngeal outlet. Killian, from pharyngoscopy and anatomical observations, demonstrated that the transverse fibres of the

cricopharyngeus act as a sphincter to the upper end of the œsophagus, and Goldmann[12] has confirmed this by interesting observations on two patients during an operation for goitre. The pharynx and œsophagus presented themselves as moderately-filled air sacs, and were separated by a ring constriction which lay at the level of the lower half of the cricoid. When the patient swallowed, the saliva was seen to bound against the constriction, and, after a short time, the ring opened, and the pharynx and œsophagus became continuous. Immediately thereafter the constriction formed again. Recently, we have had a convincing proof of the sphincteric action of the lower part of the pharynx in a case of suicidal cut-throat. The larynx had been completely divided immediately above the true vocal cords, and only the posterior wall of the pharynx remained intact. A finger passed down the pharynx encountered a conical contracted sphincter at the level of the lower half of the cricoid cartilage. The patient was asked to swallow. The muscles on the posterior pharyngeal wall contracted, partially elevating the larynx, and, almost simultaneously, the sphincter relaxed. The opening of the sphincter was sudden, and, after a brief interval of from half to one second, slowly closed again. It is easy to conceive that inco-ordinate relaxation of this sphincter would considerably increase the intra-pharyngeal tension, and that the strain would be maximum at the point at which the bolus is arrested. In the two cases observed by us, a definite difficulty in swallowing had been noted, in one case for fifteen years and in the other ever since boyhood, and such cases are by no means exceptional. Further, there are cases on record in which there was noted a definite organic stenosis[17, 18] at the upper œsophageal extremity, some of congenital origin, some fibrotic; and it is noteworthy that the examples of diverticula in early life have been associated with such stenoses.[6] Trauma has been cited as the predisposing cause in a few cases, but its etiological relationship is difficult to establish and must be regarded as exceptional.

Once the protrusion has begun, the displacement forwards of the upper aperture of the œsophagus renders still more difficult the passage of food into the œsophagus, and the propulsive force of the pharynx is expended in dilating the pouch. In accord with this is the phenomenon so consistently noted, that nothing enters the œsophagus until the pouch is filled. Radioscopic examination in one of our cases confirmed the observation of Hartmann[19] that food distends the neck of the filled sac and then overflows into the œsophagus.

From the foregoing anatomical, physiological, and clinical observations, it may be conceded that the prime initial factor is some interference with the outlet of the pharynx. Whereas in exceptional cases there may be some readily recognizable organic stricture, in the majority of cases it is probably of a functional nature and due to an inco-ordinate action between the propulsive and sphincteric elements of the neuromuscular apparatus.

**Clinical Manifestations.**—In a number of cases there had been a history of some defect in swallowing for many years before the typical symptoms attributable to a pouch were noted. In one of our cases that difficulty dated back to boyhood, and was the only symptom manifested for thirty-seven years. It is quite possible that in the majority of cases the earliest symptoms are due, not to the pouch, but to the deranged neuromuscular mechanism of deglutition.

When a pouch has formed, the most characteristic symptom is the regurgitation, at variable periods after meals, of unaltered food. At first the quantity may be small, but it tends progressively to increase. Associated with this there are often gurgling noises which are a source of annoyance to the patient, and occasionally may be audible at a considerable distance. A noticeable symptom is an accumulation of saliva in the pharynx, and, in certain cases, rest at night may thereby be disturbed. The initial difficulty in swallowing becomes more pronounced, the sac enlarges, and in an extreme case such as the first one here recorded, the partaking of a meal is looked forward to with anxiety, and even dread. Before anything passes down the œsophagus, the patient must first fill his pouch, and any misadventure may cause regurgitation of its contents. The patient then experiences a choking sensation, bends forwards and empties the pouch, and the

ordeal has to be repeated. Only by exercising great caution when the pouch has been filled can the patient succeed in swallowing sufficient nourishment to maintain nutrition.

In moderate-sized pouches the swelling may be visible on one or other side of the neck, more often on the left side. Each swallow of the patient causes the swelling to increase in size, and the larynx and trachea may be displaced and the sternomastoid bulged forwards. When the sac is full, pressure applied to it may empty it, particularly if the patient be lying on his side. The rate of increase in symptoms varies, but on the average in a series of 35 cases[11] the time from the onset of the symptoms to the patient's undergoing operation was five and a half years.

**Diagnosis.**—In a well-marked case, the diagnosis can usually be made from clinical manifestations alone, and can be readily confirmed by radioscopic examination. In the early stage, various conditions may be confused with it, such as simple or malignant stricture of the œsophagus, and cardiospasm. In all of these there may be difficulty in swallowing, excessive salivation, and arrest of bougies ; but the true nature of the malady can always be revealed by resort to radiography. The latter has now replaced not only the use of the bougies but even œsophagoscopy, and is moreover a much safer procedure.

**Complications and Terminations if Untreated.**—The progressive difficulty in swallowing eventually leads to inanition, and in numerous cases death from starvation has resulted. Stagnation of contents may give rise to ulceration of the mucous lining, and may cause secondary suppuration in and around the wall of the sac, or lead to perforation. Intercurrent lung complications are not infrequently the cause of death. Carcinomatous degeneration has been recorded in several cases.

**Treatment.**—Hitherto, attention has been almost entirely directed to the removal of the sac. Sight must not be lost, however, of the possibility that in the sac we are dealing with merely a secondary condition, and to ensure a radical cure an effort must be made to overcome the primary cause. Thus, if an organic stenosis of the œsophagus be present, one would naturally first dilate the stricture. This principle is equally applicable to cases in which the obstruction appears to be functional in character. In very early cases, Bevan[20] recommends the passage of bougies, with the object of opening up the pouch. It is not unlikely, however, that the good resulting from this measure is due to dilatation of the pharyngeal sphincter. In very early cases it is conceivable that such measures may be the means of arresting the development of the sac. In late cases such dilatation should supplement the extirpation of the sac.

Removal of the sac, despite the recorded series of successful operations, is nevertheless to be regarded as a procedure fraught with danger. The patient is usually of advanced years and is frequently debilitated. The sac of necessity contains infective organisms, communicates with a septic channel, and lies in a cellular plane ill-fitted to deal with infection and continuous with an inaccessible space, the posterior mediastinum. The attendant risk is evidenced by the numerous operative methods that have been devised.

To combat the state of inanition, a primary gastrostomy has been strongly advocated by some surgeons, and is undoubtedly advantageous in late cases. To minimize infection from the interior of the sac, careful attention must be paid to the teeth and gums, and lavage of the sac with a mild antiseptic is a useful pre-operative practice. An empty sac is an essential for a safe operation, and measures must be taken to ensure this by posture, and by pressure over the sac immediately after the lavage and prior to the operation. Cases have been recorded in which this was not attended to, and in which aspiration of infected material led to pulmonary complications.

In regard to anæsthesia, Lüpke[21] and Bevan[20] strongly recommend local and regional anæsthesia as precluding the risks of aspiration and avoiding post-operative sickness. On the other hand, the majority of successful operations have been carried out under general anæsthesia, and, when such anæsthesia is employed, the intratracheal insufflation of ether will probably be the one of choice.

As to the methods of operation, these have been diverse, such as simple pharyngopexy, invagination of the sac, the two-stage removal, and—what would appear to be the

ideal operation—the one-stage radical extirpation of the sac. Pharyngopexy, advocated by Hill,[22] will probably be reserved for small pouches in old and debilitated subjects. Invagination is likewise only applicable when the sac is small: in the larger sacs, as pointed out by its introducer, Bevan,[20] it is not free from danger, since the invaginated sac may be displaced upwards and occlude the pharyngeal orifice.

A two-stage removal of the sac was first practised by Goldmann with a view to minimizing the risk of cellulitis in the planes of the neck, and this, with numerous modifications, has been widely adopted. Goldmann's[12] operation consists in freeing and bringing out the sac, ligating its neck with silk and gently packing around, and removing the sac at the second operation. Deis[9] carries out the same procedure, but leaves the sac to slough off of its own accord. In Mayo's[11] method, the sac is freed and the skin sutured down to its neck, and at a subsequent operation the sac is excised. Another modification is to free the sac, twist it at its neck, and gently pack around; when the fascial planes are all walled off, the sac is removed and its pedicle sutured.

The method adopted in the two cases here recorded was to offer still greater protection against the danger of cellulitis. It consists essentially in freeing and bringing out the sac at the first operation, and in a submucous excision of the lining at the second, the tunica propria being left adherent to the skin, and the planes of the neck being left undisturbed.

In the one-stage operation, the sac is isolated and removed and the neck is variously dealt with. Kocher's method is really a 'cuff' operation, and is very similar to that of dealing with an appendix stump. Perthes[21] divided the neck between clamps, and dealt with the stump after the Moynihan method of closing the duodenum in a pylorectomy, the suture-line being vertical. Lexer conserved a pedicle which he invaginated so as to form a valve-like internal protrusion. It is necessary to utter a word of warning about division of the neck. Unless great care be taken, traction on the sac may pull out a portion of the normal pharyngeal wall which may be mistaken for the neck of the sac. In a case recorded by Downes,[23] all save a narrow strip on the right lateral wall of the upper end of the œsophagus was inadvertently removed with the sac, and it was found necessary to excise the remaining portion and to do an end-to-end suture.

The one-stage operation makes an obvious appeal to the surgical instinct, and in favourable cases has much to commend it. Discretion, however, will often dictate the more tedious but surely the safer course of a two-stage operation, and it must be left to the judgement of the surgeon in the individual case to decide which is the method of choice.

Common to all the methods previously discussed is the mode of approach. The usual incision is along the anterior border of the sternomastoid. Occasionally, however, a collar incision such as is used in thyroidectomy is employed. At the anterior border of the sternomastoid the deep fascia is incised and the muscle retracted laterally. The omohyoid is freed and displaced outwards, or divided. The carotid sheath is exposed, and, after dividing the middle thyroid vein, is retracted laterally. The thyroid gland is displaced medially, and at this stage the diverticulum will be visible in the depths of the wound. Crossing it is the inferior thyroid artery, and if this impedes access it may be divided. The lateral expansion of the pretracheal layer of fascia is divided, and the sac may now be delivered. As a rule, the pouch lies amid loose cellular tissue and can be readily freed; but in exceptional cases preceding inflammatory changes in and around its wall may render this stage of the operation exceedingly difficult.

**Post-operative Course and Treatment.**—The complication most to be feared is a spreading infection of the cellular planes of the neck, with its sequela mediastinitis. As has been pointed out, this may be effectively prevented by doing the operation in two stages, and particularly by the method of submucous excision. In the one-stage operation infection may arise from contamination of the wound at operation, or, more frequently, from subsequent leakage. To avert the latter, the indications are: (1) To give rest to the wounded pharynx as far as possible, and to render as aseptic as possible the secretions of the mouth. For several days oral feeding is better avoided, glucose enemata being

administered by the rectum. Feeding through an œsophageal tube passed at the time of operation has been practised, but is no longer recommended. (2) Free drainage must be established, so that any leakage may find ready exit.

A temporary fistula is to be expected in about 50 per cent of the cases. Recently, however, some operators have recorded short series of cases with a much higher percentage of healing per primam. With few exceptions, the fistulæ close within a few weeks, and are of little moment if they do not occur prior to the sealing off of the cellular planes by granulation tissue.

## ILLUSTRATIVE CASES.

*Case* 1.—Mr. A. H., age 53. Patient states: "I can remember quite clearly that, when a boy about 9 years of age, I began to realize there was something not quite right in regard to my swallowing food. When any lumps or knots of oatmeal were present in my porridge, to swallow them without chewing was both difficult and disagreeable. Throughout early manhood I could never eat dry bread except very slowly and with a great deal of chewing, and I developed the habit of taking a fair quantity of liquid with my meals. I could always manage to obtain sufficient nourishment, provided I had plenty of time. Further, in drinking fluids such as milk or water, it had to be taken in small quantities and not drunk continuously.

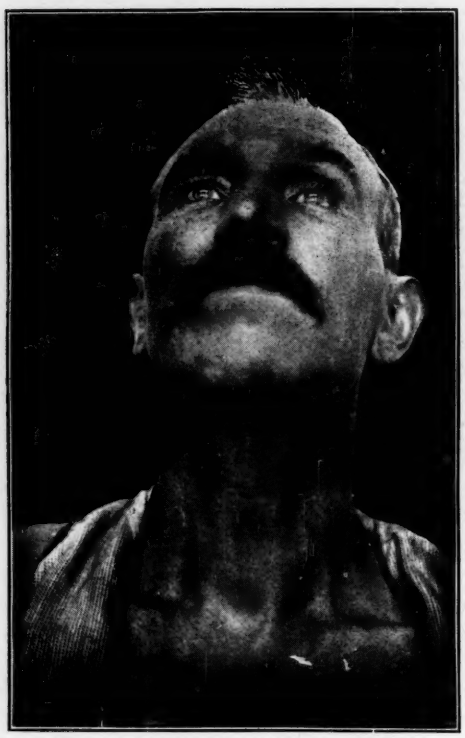


FIG. 93.—*Case* 1: With the sac empty.

FIG. 94.—*Case* 1: Sac distended with food.

"It would be about seven years ago that I first began to realize there was something radically wrong. I had a bad taste in my mouth in the morning and coughed up small quantities of substance from my throat. Six years ago I found that, hours after meals, food would come into my mouth as fresh as when I had taken it first. Further, especially at night when in bed, I was surprised by hearing gurglings in my throat; sometimes these sounds were quite pronounced.

"Three years ago, I sought advice, and radiograms were taken and a pouch was recognized. Soon thereafter I developed pneumonia. Following the attack, I discovered that I could empty the pouch by simply holding my head down over a basin. This allowed me to carry on with comparative comfort; but, during the last three years, swallowing has become nore and more difficult. Formerly I weighed 13 stone; now I weigh 11 stone 13 lb."

PHYSICAL EXAMINATION, Jan. 12, 1920.—Patient was fairly healthy in appearance, though somewhat emaciated. There was nothing to be made out on simple inspection of the neck (*Fig.* 93). Patient was given a glass of water. This he could only swallow in mouthfuls at a time. A swelling began to appear on the left side of the neck, and this grew larger with each swallow. The swelling occupied the lower carotid region and bulged into the subclavian triangle. Apparently the whole of the tumblerful had gone directly into the pouch. The water he readily brought back by holding his head on one side and pressing on the swelling in the neck. It was found that he could swallow air into the pouch if he held his nostrils. Observations were made while the patient took breakfast. His endeavour was first to fill the pouch. He took 10–15 ounces of milk with his porridge, and, with each gulp, the swelling in the left side of the neck became more prominent, until it eventually assumed the dimensions shown in *Fig.* 94. The lower half of the sternomastoid was bulged forwards and laterally, and the larynx and trachea were displaced a little to the right. When the sac was full, the patient began to have some difficulty in speaking, and he breathed with

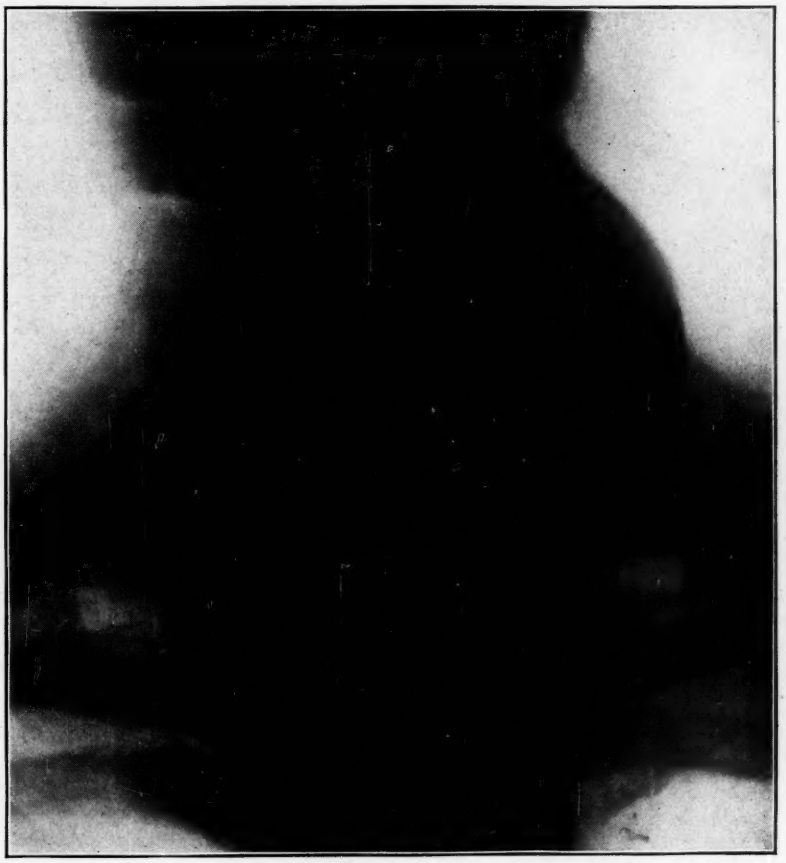


FIG. 95.—*Case* 1: Radiogram showing the sac after a bismuth meal (D. W. Hope Fowler).

caution. More food was taken, such as bread, tea, and also a little bacon, and finally Benger's Food. During the meal, for some unknown reason, a little regurgitation caused irritation, and he was compelled to lean well forward on to one side over a basin which he always had at his feet, and the whole of the contents of the sac were disgorged: he thereafter had to begin again to fill the pouch before he could get anything to pass down the œsophagus. A radiogram was taken after a bismuth meal (*Fig.* 95). The pouch will be seen to extend down into the mediastinum: he upper part of the sac is full of air, and the sternomastoid is seen bulging laterally.

OPERATION, 1*st stage*, Jan. 17.—Sir Harold J. Stiles operated, chloroform and ether being employed, and while the patient was under anæsthesia œsophagoscopy was carried out by Dr. Logan Turner. The œsophagoscope was found to pass directly into the sac, and one could see the rugose wall of the diverticulum expanding and contracting with the respiratory movements. On retracting the œsophagoscope, the orifice was observed as a vertical slit just to the right of the mid-line on the posterior wall of the lower part of the pharynx. The patient was placed in the supine position

with the head slightly turned to the right side. Incision along the anterior border of the sternomastoid from the inner end of the clavicle to about the level of the hyoid bone; from a point at the junction of the middle and lower thirds of this incision a second short incision was carried downwards and outwards. The external jugular vein was divided between clamps. The anterior border of the sternomastoid was defined and retracted outwards. The omohyoid muscle was freed and retracted upwards and outwards. The middle thyroid vein was divided between clamps and the carotid sheath retracted laterally. Deep in the interval between the carotid sheath and the trachea, the œsophagus could be seen and palpated, and behind this, extending outwards behind the carotid sheath and downwards behind the œsophagus into the thorax, was a thick-walled pouch.

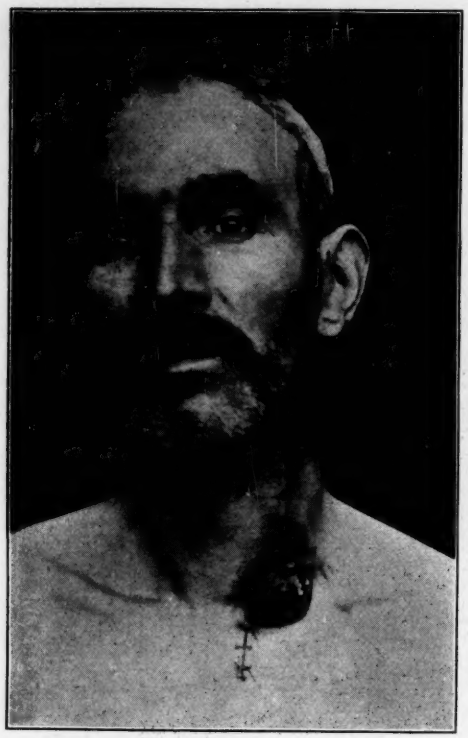


FIG. 96.—*Case* 1: After first stage of the operation.

The depressor muscles of the hyoid were freed a little more and retracted well inward with the larynx and trachea, and, after tearing through the thin lateral expansion of the pretracheal layer of fascia, the sac was grasped and dislodged from the mediastinum, a few loose fibrous connections being divided with the scissors. The neck of the pouch was defined and was found not to extend much above the level of the cricoid cartilage. The wall of the sac was thick and was comparable to that of the stomach. The fundus of the sac was brought out of the wound between the carotid sheath and the thyroid, and in front of the anterior border of the sternomastoid. The wound was closed about the sac, the skin margins being fixed to the body of the sac (*Fig.* 96).

*2nd Stage*, Jan. 29.—Chloroform and ether given. The base of the projecting portion of the sac was incised until the loose submucous tissue plane was reached. By blunt dissection the mucosa was separated off for about two inches from the skin surface, and the fundus, together with the freed mucous lining, was resected. *Fig.* 97 shows a section of the portion removed. The edges of the mucosa were picked up with catch forceps, and the finger, on being inserted, encountered the posterior aspect of the cricoid cartilage. On account of the depth, the finger could not be inserted down to the œsophagus. One could just detect the spur between the orifice of the pouch and the opening of the œsophagus.

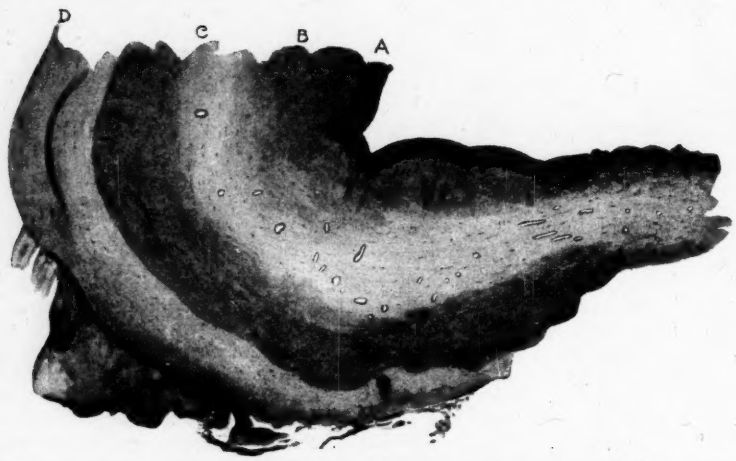



FIG. 97.—*Case* 1: Portion of fundus of sac removed at second-stage operation (Micro-section × 3). (A) Lining squamous epithelium; (B) Submucous layer; (C) Tunica propria; (D) Granulation tissue and blood-clot.

The free edge of the mucosa was inverted by a roll-in suture of chromacized catgut, and further invaginated by interrupted sutures. The stump was then allowed to retract into the

deeper parts of the wound. A little iodoform bismuth paste was smeared into the sinus, and the orifice was partially closed by means of skin sutures. It is to be noted, therefore, that the operation was carried out within the submucous layer of the diverticulum, and the planes of the neck were not opened. *Fig.* 98 shows the condition after this stage of the operation.

Post-operative Treatment.—After the first-stage operation, glucose-saline enemata were administered for two or three days, and thereafter fluid nourishment was given by the mouth. Following the second-stage operation, glucose enemata were again administered, and on the fourth day small quantities of fluid nourishment were allowed by the mouth.

The patient's condition remained excellent after both operations. On the eighth day after the second operation, a little fluid food escaped through the wound in the neck; this continued for eight or nine days and then ceased. Two and a half weeks after the second operation the patient was allowed to go home, with the wound in the neck almost closed.

The following extract from letters received from the patient show the progress of the case:—

*May* 12, 1920: "My appetite is good, and I am feeding up freely on porridge, eggs, and pudding. I can take food with little discomfort, and the wound has healed up clean and well. I have put on weight rapidly. There has always, however, been a quantity of food lodging in the throat, which I have discharged from the mouth after each meal: the amount began with about two tablespoonfuls, but is now about three tablespoonfuls. I find I cannot swallow masticated scones or meat readily, and food seems to go down in a jerky manner."

*March* 21, 1921: "My weight is now over 12 stone. My throat condition has not troubled me so much during the last four months. The quantity retained in my throat after meals does not seem to be getting any larger, and I can swallow with a little less trouble. I may say that there is nothing I cannot take, provided I get time and have a fair quantity of fluid with my meals."

*April* 4, 1922: "I can manage with care to eat and swallow practically any ordinary material. Butcher's meat, potatoes, and anything of a pasty nature seem to clog the passage, and when trying to force matters a little bit, I find the food gets 'into a pocket', and there is a prominence which can be felt by the hand on the left side of the neck. The amount of food which lodges in the throat is quite a breakfast-cupful. During the last six months, however, I am inclined to think it has not got any worse, and there is at times some feeling as if the condition was growing more comfortable. My weight to-day is 12 stone 5 lb."

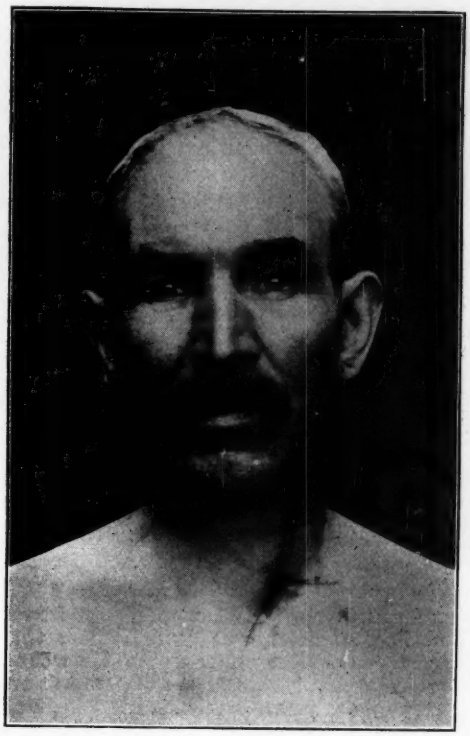


Fig. 98.—*Case* 1: After second stage of the operation.

*Case* 2.—Miss G., age 67. Complains of difficulty in swallowing, clicking noise in throat, and fullness of the neck after eating.

History.—For over twenty years patient had been conscious of a difficulty in swallowing solid food. She, however, paid little attention to it until eight years ago, when a friend remarked on a chuckling noise which she made just after swallowing. This she repeatedly noticed herself, and since its appearance swallowing became progressively more difficult. Two years ago she began to have vomiting after meals, and she noticed that what she brought up always consisted of the first part of the meal taken. She was also now considerably troubled by bringing up mucus both by day and during the night. Her medical man suggested the possibility of an œsophageal pouch. She was examined with the œsophagoscope, which was arrested one and a half inches below the level of the cricoid cartilage, and a diagnosis of carcinoma of the œsophagus was made. At this time patient weighed 6 stone 4 lb. She was put on a generous fluid and soft solid diet and thereafter steadily put on weight until at the present time she weighs 8 stone. The vomiting up of the first part of the meal, however, has continued, and the constant hawking up of mucus has become more pronounced, interfering greatly with her rest at night. She has latterly been more conscious of an uncomfortable fullness on the right side of the neck after eating, and this is only relieved by vomiting.

On Examination.—Patient is a thin and delicate-looking old lady. A slight fullness of the neck is noticeable under the lower half of the right sternomastoid muscle. On palpation, a deep-seated soft swelling can be made out to the right of the trachea. Pressure on this gives a curious dull crepitant sensation.

*X*-Ray Screen Examination.—When patient swallows bismuth it is seen to enter a pouch lying to the right of the mid-line and extending down to the manubrium sterni, the shadow being rather larger than a hen's egg (*Fig.* 99). When this pouch is filled, but not till then, the bismuth is seen to pass down the œsophagus to the left of the pouch. After the bismuth meal is all swallowed the shadow of the filled pouch remains.

Diagnosis.—Pharyngeal diverticulum lying to the right of the œsophagus. As the condition was causing great interference with the patient's comfort, and especially with her rest at night, operation was recommended. In view of her age and somewhat frail constitution, a two-stage operation was decided on.

Operation, 1*st Stage*, Dec. 6, 1921 (Mr. Wilkie, assisted by Dr. T. W. E. Ross).—To ensure that the diverticulum was relatively clean and empty, the patient was made to swallow weak boracic lotion, and then to bend over and compress the right side of the neck, thus washing out the pouch. Under chloroform an incision was made along the anterior border of the lower half of the right sternomastoid. On dividing the deep fascia the omohyoid muscle was exposed and divided. The pretracheal layer of deep cervical fascia was divided, and the pouch was exposed, lying under cover of the thyroid gland and medial to the carotid sheath. The inferior thyroid artery was visible, crossing on the anterior aspect of the pouch; it was not divided. The pouch was readily freed except at its apex, which lay just behind the episternal notch. On dividing one or two fibrous adhesions at this point it was readily brought out into the wound. It measured three and a half inches in length, and had a broad neck which rose from the posterior pharyngeal wall. The œsophagus lay directly in front of the proximal part of the sac, and a few longitudinal muscular fibres from the inferior constrictor extended on to its neck. A few horizontal muscular fibres from the pharynx were also seen on the proximal half-inch. On picking up the sac between the finger and thumb, the feeling experienced was almost identical with that on palpating the urinary bladder. On pulling forward the sac and examining it from behind, it appeared to be continuous with the pharynx, and it was difficult to detect where the sac ended and the pharynx began. The pouch was brought out at the upper end of the wound. Three linen sutures were passed through its fibrous coat near the neck, and these were left long and brought out through the wound. Two catgut sutures fixed its fibrous sheath to the depressor and sternomastoid muscles. Some ribbon iodoform gauze was packed into the space from which the sac had been removed, and a small strip into the retropharyngeal space above it. The wound was closed with silkworm-gut sutures, leaving the sac protruding from its upper end.

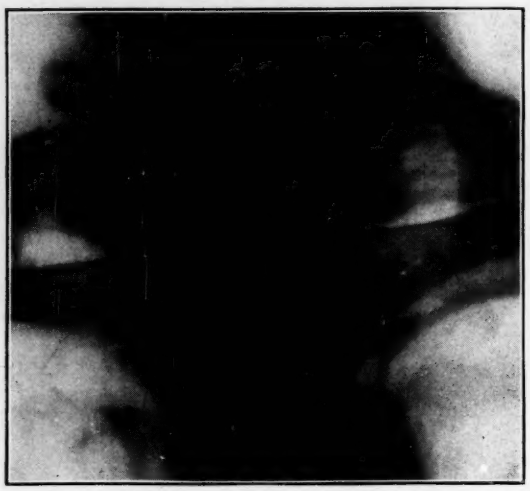


Fig. 99.—*Case* 2: Radiogram after bismuth meal (Dr. T. W. E. Ross).

The patient was given rectal salines for the first twenty-four hours and thereafter food by the mouth. On the second day she could swallow solid food without difficulty. Five days after operation the gauze packing was removed.

2*nd Stage*.—Eleven days after the first operation, under chloroform-ether anæsthesia, an incision was made at the level of the skin through the tunica propria into the submucous tissue. It was found that the mucous sac could then be separated readily down to its junction with the pharynx. Here it was caught with peritoneal forceps and the sac cut away. A finger was then introduced through the neck of the sac into the pharynx. The opening of the œsophagus was felt as a narrow transverse slit on the anterior wall of the neck. The forefinger was introduced into it with difficulty and slowly dilated it. It was then seen that the whole of the mucous lining of the neck of the sac had not been removed, and another ring three-sixteenths of an inch broad, of mucous membrane, was taken away. The cut edges were then enfolded with a roll-over suture of 00 twenty-day tanned catgut. Before this suture was completed a large-sized olivary-headed œsophageal bougie was passed by the mouth, and this showed that the pharynx had not been unduly constricted. It was clearly demonstrated that just below the suture line the bougie was arrested, and considerable pressure was required before it passed onwards into the œsophagus, and further, that on withdrawing it, it was arrested at the same point. This manœuvre was repeated and the observation confirmed. One catgut suture was put in, drawing the walls of the sheath together. Throughout the whole operation the fibrous sheath of the diverticulum remained adherent to the skin.

The microscopic appearances of the part removed are shown in *Fig.* 100.

POST-OPERATIVE COURSE.—For three days glucose enemata were given at four-hourly intervals, nothing being taken by the mouth. The mouth was washed out every two hours with phenol sodique, and the patient sucked formamint tabloids on her own suggestion. On the fourth day she was given sterile water to swallow and on the fifth day clear soup. Thereafter, a more generous diet of various sterilized liquid foods was given. On the eighth day a small fistula developed and remained open for five weeks, when it finally closed. Very little ever came through the fistula even when liquids were swallowed. There was no cellulitis of the neck or other complications. The patient went home six weeks after the second operation with the wound healed, and could swallow ordinary solid food without difficulty.

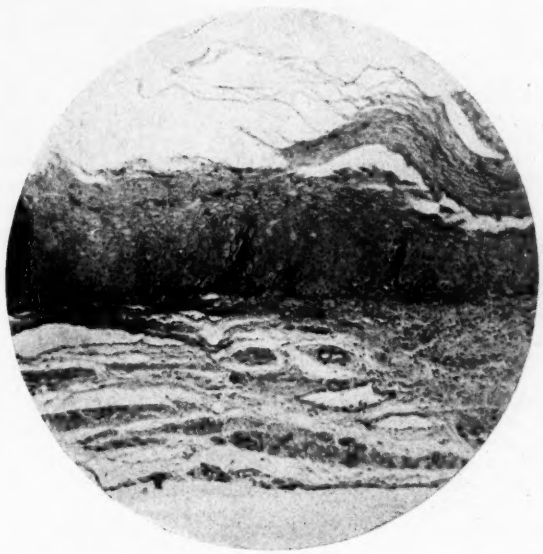


FIG. 100.—*Case* 2: Micro-photograph of portion of pouch removed at the operation.

The points of special interest in this case are the right-sided position of the diverticulum, and the determination during the second operation that the upper œsophageal sphincter was narrowed and offered a definite resistance when a finger and a large bougie passed through it. The latter procedure it was hoped, and with some reason, would have a beneficial therapeutic effect in facilitating swallowing and preventing undue intrapharyngeal pressure.

## CONCLUSIONS.

1. A pharyngeal diverticulum is an abnormal protrusion of the mucous membrane of the lower part of the posterior wall of the pharynx, between the oblique and transverse fibres of the cricopharyngeus muscle.

2. It occurs most frequently in men past middle life.

3. The condition is more common than has hitherto been supposed, for, although only some 200 cases have been recorded, the majority of these have been within comparatively recent years.

4. Two etiological factors are involved: the one—a weakness of the wall—is problematical; the other is increased intrapharyngeal pressure.

5. In exceptional cases, an organic stenosis has been present: in the majority, the primary cause would appear to be the inco-ordinate action between the propulsive and sphincteric elements of the pharyngeal muscle.

6. Radioscopy has replaced all other special diagnostic methods.

7. Treatment must be directed to both cause and effect, by dilatation of the stenosis, be it organic or functional, and extirpation of the sac.

**8. The one-stage operation is ideal, but not devoid of danger, the chief risk being leakage and cellulitis of the planes of the neck.**

**9. The two-stage operation is that recommended in feeble and elderly patients.**

**10. The modification of the two-stage operation, in which a submucous excision of the sac is made at the second stage, though perhaps not the most radical, is, however, the one involving least risk to the patient's life.**

---

REFERENCES.

[1]ROSENTHAL, *Pulsion divertikel des Schlundes*, 1902.
[2]MONDIÈRE, *Arch. gén. de Méd.*, 1833, xxiv.
[3]CHARLES BELL, *Surgical Observations*, 1816, Part 1, 67.
[4]ROKITANSKY, *Lehrb. d. path. Anat.*, 1861.
[5]ZENKER, *Ziemssen's Encyclop. of Med.*, 1878, viii.
[6]NICOLADONI, *Wien. med. Woch.*, 1877, No. 25.
[7]VON BERGMANN, *Arch. f. klin. Chir.*, 1892, xliii.
[8]KOCHER, *Cor.-Blatt, f. schweiz. Aerzte*, 1892.
[9]KURT DEIS, *Beit. z. klin. Chir.*, cxxiii, 623.*
[10]H. T. BUTLIN, *Brit. Med. Jour.*, 1903, July 11.
[11]E. S. JUDD, *Collected Papers of the Mayo Clinic*, 1918.
[12]E. E. GOLDMANN, *Beit. z. klin. Chir.*, lxi, 747.
[13]A. KEITH, *Brit.Med. Jour.*, 1910, Feb. 12.
[14]R. J. GODLEE and T. R. H. BUCHNALL, *Lancet*, 1901, May 18.
[15]STETTON, *Ann. of Surg.*, 1910, 300.
[16]A. E. HALSTEAD, *Ibid.*, 1904, Feb., 171.*
[17]WORTHINGTON, *Med. Chir. Trans.*, 1847, xxx, 199.
[18]BILTON POLLARD, *Brit. Med. Jour.*, 1907, i. 1039.
[19]H. HARTMANN, *Bull. de l'Acad. de Méd.* S3, lxxxiii, 410.
[20]A. D. BEVAN, *Trans. Amer. Surg. Assoc.*, xxxviii.
[21]H. LÜPKE, *Beit. z. klin. Chir.*, cxxi, 612.*
[22]W. HILL, *Proc. Roy. Soc. Med.*, (Sect. of Laryngology), 1918, xi, 60.
[23]DOWNES, *New York Surg. Soc.*, 1912, i, 160.

* Bibliography.

# THE REMOTE EFFECTS OF GUNSHOT WOUNDS OF THE HEAD.

By L. BATHE RAWLING, London.

## SYNOPSIS.

I.—Introductory.
II.—Scalp-wounds.
III.—Non-penetrating wounds.
IV.—Penetrating Wounds :—
*a.* With Hernia Cerebri.
*b.* With Foreign Bodies Retained in the Brain.
V.—Perforating Wounds.
VI.—Fractured Base.
VII.—General Remarks on the Remote Effects of Head-wounds, with Special Reference to Headache, Fits, etc.
VIII.—Decompression, with Details of 40 Cases.
IX.—Closure or Protection of Apertures in the Skull.
X.—Postscriptum.

## I. INTRODUCTORY.

Sufficient time has now elapsed since the Great War to justify expression of opinion as to the remote effects of gunshot wounds of the head, and other head-injuries of warfare. I have, at any rate, some justification for so doing, for, from 1914–20, I was in touch with this class of case (1st London General 1914–16 ; 34th (Welsh) General, India, 1916–18 ; 1st and 4th London Generals 1918–20 ; and from 1920 onwards, at the Ministry of Pensions Hospital, Ruskin Park).

Although service in India brought to my experience some new and interesting facts connected with gunshot wounds of the head, and malarial and heat-stroke cases with head complications, it was during the first six months of 1918 that I encountered the great mass of material which forms the basis of this paper. During that time I was in charge of 150 beds reserved for head cases at the 1st London General Hospital, together with another 100 at a convalescent home to which recovering cases were sent, and these 250 beds were usually occupied by head cases of all sorts and of all grades of severity.

Stress of work, foreign service, and the general conditions prevailing, prevented me during the war from investigating the cases in the most desirable manner, but I have kept in touch with a considerable number of the men, many of whom write to me from time to time, and some of whom I see periodically. This paper is based on these cases, supplemented by observations carried out since, both at St. Bartholomew's and at the Pensions Hospital. At the latter hospital I am in constant touch with patients suffering from head injuries, and the investigation of these cases, in the comparative leisure of peace-time, has enabled me to curb enthusiasm, to modify earlier ideas, and to concentrate on the more practical points.

During the winter of 1920 and onwards, being in possession of details of 1000 cases, I was desirous of obtaining facts from that number ; but some had to be eliminated, 750 remaining. To these a form was despatched, requesting full information as to present condition, working capacity, etc. Replies were received from 452, from all parts of the world, the United Kingdom, ranch and town in Canada, Australia, New Zealand, Africa, and elsewhere.

The results here tabulated may, therefore, be regarded as representing the conclusions to which I have come after no inconsiderable experience. I would add also that, to avoid any bias, I have not read the Report on Head Injuries, issued by the Research Society, preferring to come to my own conclusions, irrespective of the opinions of those distinguished neurologists and surgeons who, sitting together, issued that report. If my ideas differ from theirs, time will show which is the correct view.

The injuries in these 452 cases represented :—

| | Cases |
|---|---|
| Scalp-wounds .. .. .. .. .. .. | 47 |
| Non-penetrating wounds .. .. .. .. | 121 |
| Penetrating wounds .. .. .. .. .. | 207 |
| Perforating wounds .. .. .. .. .. | 21 |
| Fractured base .. .. .. .. .. | 16 |
| Decompression .. .. .. .. .. | 40 |
| Total | 452 |

## II. SCALP-WOUNDS.

Scalp-wounds are usually regarded as of trivial nature—the bone is unbroken, and therefore the injury is of no serious import. Indeed, in comparision with the fearsome gunshot wounds of the head so frequently seen, the deduction seems fairly obvious. There is, however, another side to the picture, and the reports received from 47 cases of scalp-wound, in their life-history up to six years subsequent to the reception of the injury, show that there is another aspect in the consideration of scalp-wounds.

In most of these 47 cases the injury was incurred during a 'blowing-up' process, the patient often being ignorant as to what really happened. In the remainder, glancing shell-fragments had usually produced the wound.

An examination of record cards, and close scrutiny of the history, clearly show that in 22 cases (47 per cent) the injury was followed by a phase or syndrome which could be explained by no other hypothesis than that the patient was suffering from symptoms clearly pointing to definite contusion or laceration of the brain, or to intracranial hæmorrhage. The facts in these 22 cases which give rise to this statement are as follows : In 12 cases the injury was followed by a period of constant and severe headache, often of so definite a character as to be the outstanding 'memory' of the case, the one thing that the patient remembers after all these years, and of which some are in dread of recurrence. These headaches were unquestionably due to a general increase of intracranial pressure, secondary to intracranial blood extravasation, with secondary œdema of the brain. This is confirmed by the statement in many record cards that lumbar puncture, frequently repeated, was carried out for the relief of the headache, in many cases with the withdrawal of blood-stained cerebrospinal fluid. In 6 cases the injury was followed by fits of the Jacksonian type, by localized paralyses, sensory disturbances, aphasia, etc., and in 5 of these cases the fits or paralyses persist at the present time. It is obvious, therefore, that the scalp-wound in these cases was complicated by a localized cerebral laceration or hæmorrhage. In 4 cases the injury was followed by a prolonged period of unconsciousness, accompanied by slowing of the pulse-rate, raising of the blood-pressure, vomiting, etc., all symptoms indicative of intracranial blood extravasation, with generalized œdema of the brain.

These 22 cases, all of which were *x*-rayed, with negative findings in respect to osseous injury, may be accepted as proof of the contention that intracranial complications were present, the lesion being in each case of such a nature as to produce definite clinical signs and symptoms.

In the remaining 25 cases the reports were not so clear ; but in view of the significant facts elucidated in the 22 cases, it is obvious that the after-history of these scalp-wound cases should be interesting, perhaps also offering a guide to the early treatment of such wounds in the future.

THE REMOTE EFFECTS IN 47 CASES OF SCALP-WOUND.

| | |
|---|---|
| Do you suffer from *Headaches?* .. .. | Yes, 38 (severe 23, slight 15); No, 9. |
| „ „ „ *Insomnia?* .. .. .. .. | Yes, 17; No, 30. |
| „ „ „ *Giddiness?* .. .. .. .. | Yes, 31; No, 16. |
| „ „ „ *Nervousness?* .. .. .. | Yes, 25; No, 22. |
| „ „ „ *Any form of paralysis?* .. .. | Yes, 7; No, 40. |
| „ „ „ *Fits?* .. .. .. .. | Yes, 5; No, 42. |
| Are you improving? .. .. .. .. .. | Yes, 29 (60 per cent). |
| Are you stationary? .. .. .. .. .. | Yes, 16 (34 per cent). |
| Are you getting worse? .. .. .. .. | Yes, 2 ( 4 per cent). |
| Are you at work, what work and hours?— | |
| No work .. .. | 5 (10 per cent). |
| At work .. .. | 42 (light 19 per cent, ordinary 70 per cent). |

It seems to me that the outstanding feature in these cases is this—in spite of the fact that 81 per cent complain of headaches, 66 per cent of giddiness, 53 per cent of nervousness, 15 per cent of paralysis, 10 per cent of fits, yet 89 per cent are working. It must be concluded, I think, looking at the question from the broad point of view of present-day psychology, that the symptoms of which the patients complain, apart from fits and paralyses, must be of the minor type.

Nevertheless there remain the 10 per cent incapacited from work by reason of fits and palsies, and by severe and persistent headaches. It is probable that some of these would have benefited by early active treatment. Anyhow, it is about time that the expression 'only a scalp-wound' was forgotten, and that every case was treated on its own merits—with a clear basic understanding that the great majority of scalp-wounds of war time are associated with some degree of concussional cerebral change, amounting in many cases to cerebral laceration and contusion, intracranial hæmorrhages, etc.

Every case, therefore, demands the most careful investigation, with special reference to the prolongation of unconsciousness, pulse-rate, blood-pressure, persistence of headache, etc. Apart from benefit that might accrue by early operative treatment in selected cases, all cases require prolonged rest and convalescence, and many of these patients must be regarded as totally unfit for further active service.

In confirmation of these statements I would draw attention to a paper in *Brain*, vol. xlii, by Geoffrey Jefferson, on the neurological findings in 54 cases of scalp-wound. These cases were seen and treated at a Base Hospital in France and "in only five were no such evidences present". There were eleven definite local contusions of the motor cortex.

Jefferson's statements as to the earlier conditions, and my findings as to remote effects, are significant.

### III. NON-PENETRATING WOUNDS: DURA MATER NOT PENETRATED.

This section refers to various fractures of the skull, many complicated by the presence of hæmorrhages and brain injury, but all having an intact dura mater.

ANSWERS WERE RECEIVED FROM 119 CASES.

| | | |
|---|---|---|
| *Headaches* .. .. | Yes, 110 = 92 per cent; | No, 9. |
| *Insomnia* .. .. | Yes, 59 = 50 „ | No, 60. |
| *Giddiness* .. .. | Yes, 92 = 77 „ | No, 27. |
| *Nerves* .. .. | Yes, 85 = 71 „ | No, 34. |
| *Paralyses* .. .. | Yes, 24 = 20 „ | (Hemiplegia, diplegia, sup. long. sinus syndrome, aphasia, sensory disturbances, etc.) |
| | No, 95. | |
| *Fits* .. .. .. | Yes, 16 = 13 per cent.; | No, 103. |

| | | |
|---|---|---|
| *Present condition.*—Improving .. .. .. .. | 24 per cent. | |
| Stationary .. .. .. .. | 73 „ | |
| Getting worse .. .. .. .. | 2 „ | |
| *Work capacity.*—Incapable .. .. .. .. | 23 = 19 „ | |
| Light work .. .. .. .. | 29 = 24 „ | |
| Normal .. .. .. .. | 67 = 56 „ | |

## IV. PENETRATING WOUNDS.

*a.* With Hernia Cerebri. *b.* With Retention of Foreign Bodies.

Requests for information were sent to 206 cases of penetrating wounds of the head. I possessed, as in all other cases referred to in this paper, brief but moderately accurate notes as to the nature of the initial lesion, and the operative findings. This series of 206 cases includes 35 where a hernia cerebri developed soon after the injury, 42 in which foreign bodies remained in the brain substance too deep for attempts at removal, 19 with extensive extra- or subdural hæmorrhage (due to sinus injury, middle meningeal hæmorrhage, cerebral laceration), and many others in which foreign bodies had been removed from the brain.

The serious nature of some of these cases may be demonstrated by a few examples :—

*Case* 1.—Penetration of parietal region, shrapnel bullet retained in the very centre of the brain. Now suffering from slight headaches, nervousness, and some anæsthesia, but doing light work.

*Case* 2.—Penetrating wound of frontal region, followed by gas gangrene. Now well, except for occasional slight attacks of epilepsy.

*Case* 3.—Penetration of frontal region, followed by hernia cerebri, and abscess of the brain. Foreign body remains deep in the base of the lobe. Well, except for occasional slight seizures.

*Case* 4.—Penetration of parietal region, bullet removed from brain, followed by maggot infection of brain. Now working as a tram conductor.

Requests for information elicited the following replies :—

| | | | |
|---|---|---|---|
| *Headaches* | .. | Yes, 196 = 95 per cent (severe 24, slight 172) ; | No, 10. |
| *Insomnia* | .. | Yes, 93 = 45 ,, | |
| *Giddiness* | .. | Yes, 152 = 73 ,, | |
| *Nervousness* | .. | Yes, 152 = 73 ,, | |
| *Paralyses* | .. | Yes, 73 = 35 ,, | |
| *Fits* | .. .. | Yes, 72 = 35 ,, | |
| *Present condition.*—Improving | .. .. .. | 61 = 29 per cent. | |
| Stationary | .. .. .. | 130 = 63 ,, | |
| Worse | .. .. .. .. | 15 = 7 ,, | |
| *Work capacity.*—No work | .. .. .. | 79 = 38 ,, | |
| Light work | .. .. .. | 49 = 24 ,, | |
| Normal work | .. .. .. | 78 = 38 ,, | |

On analyzing further the 79 cases incapable of work in regard to the nature of their original injury, it was found that :—

20 had suffered from hernia cerebri ;
19 had foreign bodies in various parts of the brain ;
3 had suffered from extensive abscess formation of the brain ;
5 had suffered from extensive intra- or extradural hæmorrhage ;

and, on going further into the actual cause which, at the present time, incapacitates them from work, the evidence showed that :—

25 suffer from paralysis and fits ;
13 ,, ,, paralysis only ;
17 ,, ,, fits only ;
24 ,, ,, headaches, nervousness, want of concentration and loss of memory—18 being frontal injury cases.

I might add that : (1) In addition to the 35 cases of hernia cerebri, 22 other cases of hernia cerebri died in hospital—57 cases in all, with a mortality of 39 per cent ; and (2) In addition to the 42 cases with foreign bodies retained who recovered, 19 others died in hospital, all from spreading infection of the brain and meninges—mortality 31 per cent.

(It should be noted, therefore, that a death-rate from hernia cerebri of 39 per cent, and from retention of foreign bodies, with subsequent spreading infection of the brain, of 31 per cent, in base hospital at home, should be added to the death-rate from these two conditions as occurring in hospitals in France, etc.)

The table appearing at the end of *Section* VI, demonstrating the remote effects in relation to the severity of the lesion, shows clearly that penetrating wounds with hernia cerebri head the list—the most severe after-effects and the least work capacity.

### V. PERFORATING WOUNDS.

Inquiries from 19 cases brought the following replies :—

| | | |
|---|---|---|
| *Headaches* .. .. .. | Yes, 17 = 89 per cent ; | No, 2. |
| *Insomnia* .. .. .. | Yes, 10 = 53 ,, | |
| *Giddiness* .. .. .. | ,, 15 = 79 ,, | |
| *Nerves* .. .. .. | ,, 12 = 63 ,, | |
| *Paralyses* .. .. .. | ,, 6 = 32 ,, | |
| *Fits* .. .. .. | ,, 3 = 16 ,, | |
| *Present condition.*—Improving .. .. .. | 4 = 21 per cent. | |
| Stationary .. .. .. | 15 = 79 ,, | |
| Getting worse .. .. .. | 0 | |
| *Work capacity.*—Incapable .. .. .. | 21 per cent. | |
| Light .. .. .. .. | 26 } = 79 per cent. | |
| Ordinary .. .. .. | 53 } | |

These 19 perforating wounds of the head were of all varieties and directions, antero-posterior, lateral, and oblique, but in no case was there any retained metallic or osseous fragment, all foreign bodies had passed through or had been removed, nor were there any cases of hernia cerebri. In some it was to be concluded that there had been ventricular involvement.

It is rather astounding to note that the general after-result of this, the most extensive and serious injury of the head which is compatible with life, is followed by such, relatively, satisfactory results. Headaches were less severe, and—with the exception of two cases—paralyses and fits less evident than in penetrating wounds.

| | Headaches | Paralysis | Fits |
|---|---|---|---|
| Penetrating wounds .. | 95 per cent | 35 per cent | 35 per cent. |
| Perforating wounds .. | 89 ,, | 32 ,, | 16 ,, |

Furthermore, the work capacity of these perforating cases was of a high order.

| | Perforating Wounds | Penetrating Wounds |
|---|---|---|
| No work .. .. .. | 21 per cent | 38 per cent. |
| Light .. .. .. .. | 26 } = 79 per cent | 24 ,, |
| Ordinary .. .. .. | 53 } | 38 ,, |

It should be noted also that 21 per cent perforating cases stated that they were improving, 79 per cent remaining stationary, and that in no case were the conditions getting worse.

### VI. FRACTURED BASE.

Fourteen cases of fracture of the base of the skull were admitted under my care. They presented no special features, but were similar in all respects to those fractured-base cases that are seen in ordinary civil practice. As a rule they had been transferred to England soon after the injury, and on admission were suffering from headaches, mental sluggishness, ocular palsies, facial paralysis, monoplegia, aphasia, etc. Obviously, as in cases seen in ordinary hospital life, the basal fracture was of itself of little importance, the issue being dependent on the extent of associated intracranial injury. All these cases recovered, three or four after prolonged convalescence. No operations were performed on these cases other than occasional lumbar puncture for the attempted relief of the more severe grades of headache. In this late-history, the following results were obtained :—

| | |
|---|---|
| *Headaches* .. .. .. .. .. | 12 = 85 per cent. |
| *Insomnia* .. .. .. .. .. | 9 = 64 ,, |
| *Giddiness* .. .. .. .. .. | 13 = 93 ,, |
| *Nervousness* .. .. .. .. .. | 10 = 71 ,, |
| *Paralyses* .. .. .. .. .. | 3 = 21 ,, |
| *Fits* .. .. .. .. .. .. | 2 = 14 ,, |
| *Present condition.*—Improving .. .. .. | 3 = 21 ,, |
| Stationary .. .. .. | 10 = 71 ,, |
| Getting worse .. .. | 1 = 7 ,, |
| *Work capacity.*—Incapable .. .. .. | 2 = 14 ,, |
| Light .. .. .. .. | 5 = 36 ,, |
| Ordinary .. .. .. | 7 = 50 ,, |

*Table I.*—Showing the Remote Effects of Gunshot Wounds of the Head in Relation to the Injury received.

| Nature of Injuries | Headaches | Insomnia | Giddiness | Nerves | Paralyses | Fits | Present State *a*, Improving. *b*, Stationary. *c*, Worse. | | | Work Capacity *d*, None. *e*, Little. *f*, Ordinary. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *a.* | *b.* | *c.* | *d.* | *e.* | *f.* |
| I.—Scalp-Wounds - - *per cent* | 81 | 36 | 66 | 53 | 15 | 10 | 60 | 38 | 4 | 10 | 19 | 70 |
| II.—Non-penetrating Wounds *per cent* | 92 | 50 | 77 | 71 | 20 | 13 | 24 | 73 | 2 | 19 | 24 | 56 |
| III.—Penetrating - - *per cent* | 95 | 45 | 73 | 73 | 35 | 35 | 29 | 63 | 7 | 38 | 24 | 38 |
| IV.—Penetrating, with Hernia *per cent* | 86 | 46 | 75 | 75 | 46 | 54 | 43 | 54 | 3 | 69 | 20 | 10 |
| V.—Penetrating, with retained Foreign Bodies - *per cent* | 93 | 31 | 76 | 71 | 33 | 33 | 21 | 67 | 12 | 43 | 36 | 22 |
| VI.—Perforating - - *per cent* | 89 | 53 | 79 | 63 | 32 | 16 | 21 | 79 | 0 | 21 | 26 | 53 |
| VII.—Fractured Base - *per cent* | 85 | 64 | 93 | 71 | 21 | 14 | 21 | 71 | 7 | 14 | 36 | 50 |
| Average - *per cent* | 89 | 46 | 77 | 68 | 29 | 25 | 31 | 63 | 5 | 30 | 26 | 43 |

N.B. All figures are in percentages.

## VII. GENERAL REMARKS ON THE REMOTE EFFECTS OF GUNSHOT WOUNDS OF THE HEAD, AND OTHER HEAD INJURIES: WITH SPECIAL REFERENCE TO HEADACHES, FITS, RETAINED FOREIGN BODIES, PALSIES, ETC.

"In addition to those fearful headaches from which I suffered, but which are now much better as the result of your operation, I get terribly nervous when going about the streets. I'm always thinking I'm going to see someone knocked down by a car. The noise of back-firing of a car or cycle has a very bad effect on me. On such occasion my legs refuse to carry me, my knees go away from me. Concentration I find difficult, and in many cases impossible. Reading, except light stuff, is impossible. I've some terribly violent fits of temper, arising from trivial things, I find difficulty in controlling myself and lose control at most unexpected times. I sometimes have the feeling that I am going unconscious. Several people have thought at times that I was drunk. I'm T.T. I'm living a quiet life, and trying hard to fight above complaints."

This letter, one of the replies received to my inquiries, is typical of many others. It is so vivid a description of the general after-effects of a gunshot wound of the head that it is utilized as a text to this section.

Although the headaches are so frequently the outstanding, predominating feature in the case, it is quite clear that they are merely part of a more generalized state, one feature of a *syndrome*. I have dealt with this question in two previous publications,[1] and propose merely to recapitulate a few points.

In the syndrome are included the following conditions: (1) *Headaches*; (2) *Giddiness*; (3) *Insomnia*; (4) *Mental anxiety, depression, irritability of temper, and ready fits of violent passion*; (5) *General tremulous condition, shaking hands and uncertain gait*; (6) *Slight exaggeration of knee-jerks, with spurious ankle-clonus*; (7) *Fits* (*'fainting', epileptiform, and epileptic*).

Since these symptoms occur with such frequency after gunshot wounds of the head, it is fair to argue that they all have some common cause, and I purpose trying to prove that, in many cases, at any rate, they are associated with, and dependent on, a generalized condition of *cerebral œdema*. This statement is obviously not final and conclusive; but it can be proved, at any rate (*a*) that in most cases there is a great excess of cerebrospinal fluid, and (*b*) that the removal and drainage of the excess brings about, almost instantaneously, a great relief of all symptoms.

It is necessary to take the most obvious symptom, *headache*, as a guide, noting carefully the presence or absence of excess fluid in those more severe cases that come to operation, observing the immediate results obtained, but withholding final judgement till such time shall have elapsed as will justify one in coming to more or less final conclusions. This is the course that I have adopted. The second of the two earlier publications on the subject was published in April, 1919, and three years have elapsed, or nearly so. The theories there advanced have received ample confirmation, not only from other cases of gunshot wound of the head, but also from many cases of civil practice, and from reports on cases operated on by other surgeons. Operation was only advised, and carried out, when my hand was forced, in the worst type of case—in those patients who were 'fed-up', wearied with the incessant pain. In those earlier papers I was cautious in my prognosis; I was uncertain whether the great and immediate benefits would be maintained. Sufficient time has elapsed to enable more definite statement. The late results are here published of 40 cases of subtemporal decompression, where this operation was advised and conducted with the main object of headache relief. These cases are described and scheduled later. The results, taking them as a whole, are satisfactory.

### 1. HEADACHE.

By reason of its frequency of occurrence, its intensity and severity, its incapacitating effect on the patient, as also by its pathology and relief on decompression, headache forms perhaps the most interesting of the remote effects of head injuries, whether gunshot wounds or civil injuries. At the present time, four to eight years after the injury, 88 per cent of the cases from whom replies were received still suffer from headaches, varying

from slight and inconstant to severe and incessant, with, in these worst cases, periods of utter prostration, completely incapacitating them from work and rendering their lives miserable. The maximum percentage of headache was seen in penetrating wounds of the head, 95 per cent, the slightest degrees in cases of scalp-wound only, 81 per cent. Thus, by reason of the frequency and severity of headache, it is obvious that no apology is needed in considering the question fully.

In the great majority of cases the headaches date from the time of the original injury, and some patients still shudder at the horrible headaches they suffered from after regaining consciousness. Indeed, in many cases, the fact is noted in the history-card, and lumbar puncture was frequently carried out for its relief. The average after-history of these cases runs somewhat as follows: some weeks or months later, the headaches diminished in intensity and frequency, either finally reaching the slight and inconstant stage, so frequently observed at the present time, or showing little or no amelioration, remaining constant and severe.

In some, the earlier remission has been followed, during the last year or so, by a return to the earlier conditions, by relapse and exacerbation, often as the result of a return to work under the present difficult trade condition. Doubtless, family considerations, with attendant anxiety, have tended to add to the conditions aiding relapse. In others, after two or three years of comparative remission, the headaches have returned, sometimes in a severe form.

As seen at the present day, the patients suffering from the more severe grades of headache present a very typical facial appearance. It is easy to diagnose the condition as soon as the patient is seen—dour expression, fixed features, seldom relaxing and relapsing into smiles or more cheery expression, features outwardly expressive of headache—eyes of pain, with lids half-closed, frowning—the typical appearance of one suffering from headache. They are little interested in their surroundings, only too eager to accept any suggestion of operative treatment, with the hope of finding some relief from their condition. "I don't care if you cut my head off" is a common reply to suggestion as to operation. The life is utterly miserable, and a conversation with the wife or sister is quite enough to clinch the argument as to whether operation is justifiable or not.

Many of these patients are soaked in bromides, etc., and their depressed state must be considered in that light. A period of remission from narcotics should be advised and carried out previous to final conclusions. I wish to urge, and point out, that operation should be considered only when all other measures fail. That has been my custom, otherwise I would have reported on 400 cases of subtemporal decompression instead of 40.

In the majority of cases the headaches are localized to the frontal region, sometimes to the occipital, more rarely to the vertex, with now and again a definite indication as to the localization of the pains to the region injured. Sometimes the pains are temporal or bi-temporal in position. Usually, however, "behind the eyes" is the complaint—"my eyes feel as if they were bursting".

In regard to the time of onset, provided that the pains were inconstant, the headaches were most marked early in the morning, on waking. The next most frequent time of occurrence was about 5 o'clock. In all cases the headaches were intensified by exertion, bus rides, cinematographs, etc. Family rows were exceedingly conducive to further trouble. In the more severe attacks the patients retired to their rooms or their beds, only demanding quiet—curled up in bed, in the typical condition of cerebral irritation. Such cases were only too eager to be taken into hospital where they could be away from the noises of the house, rampageous children, etc.

In some cases the headaches are of a 'cyclic' character, recurring every two or three days, perhaps with a week's remission; comparative freedom, and then the attack, then freedom again till the next bout.

In relation to atmospheric and climatic surroundings these patients are regular 'barometers'. A ward visit on a dull and heavy day with marked humidity, shows that almost every head-case has a headache, the more serious cases being miserable in bed.

On a bright and clear day, especially in the cool weather of spring and winter, the conditions are reversed, all are comparatively bright and smiling.

Stuffy rooms, engineering workshops, with their noises and clangings, are bad for these patients. Open-air life, with light work, is markedly beneficial.

The prostrating attacks are often accompanied by a slight rise of temperature, 99°–100°, with moderate degree of rise in blood-pressure, combined with some slowing of the pulse-rate. Marked distaste for food, with some nausea but no vomiting, and insomnia, accompany the attack.

The discs rarely show any definite changes, amounting in the more severe cases to some engorgement of the retinal veins. I have yet to meet a case with true papillœdema.

In some cases the headaches are associated with an outburst of fits, usually of the epileptiform type, and it is remarkable that in some cases where there is a definite association of headaches and fits, the headaches very definitely lead up to the 'fit' development —the headaches gradually get worse till "my head seems as if it were bursting", then comes the fit. And so on, till the next occurrence.

Now, as to the causation of these headaches. In the first paper published on this question, in 1918, it was stated that they were dependent on an increase of intracranial pressure, and that the increase of pressure was due, in the great majority of cases, to an excess of cerebrospinal fluid, the general sodden appearance of the brain and meninges giving rise to the term applied to the condition in general—*cerebral œdema*. This statement is proved by the two following facts: (*a*) The presence of excess fluid as found at operation; (*b*) The immediate relief produced by the operation—lessening of the intradural pressure in subtemporal decompression, and the provision of a door for the escape of excess fluid.

*a. At the operation of subtemporal decompression*, the routine operation carried out for the conditions present, the appearances of the brain are absolutely typical—the dura mater, when incised, allows of the immediate escape of excess cerebrospinal fluid, sometimes spurting out at high pressure in the form of a jet. When the dura mater is more extensively incised, the brain appears water-logged by excess fluid over the whole of the brain surface exposed, most marked in the line of the vessels as they run in their sulci. These vessels would appear, by reason of this fluid surrounding them, as white œdematous streaks. The fluid is seen to be exuding freely through the arachnoid, as drops or tears, these running together in rivulets, these again coalescing, forming a pool at the lower angle of the wound, trickling away on the towels. On gentle pressure with gauze over the surface of brain exposed, the excess fluid in the subarachnoid space is squeezed aside, and, on the removal of the pressure, reaccumulates rapidly—altogether a very definite and typical picture, a very wet sponge. The removal of bone in a subtemporal decompression is so planned that it is easy to insinuate a broad spatula beneath the temporo-sphenoidal lobe, and when this is done the great accumulation of excess fluid at the base of the brain is well demonstrated—lifting up the brain, and then allowing it to fall back again, each such manœuvre being followed by the escape and evacuation of considerable excess cerebrospinal fluid.

There can be no question, therefore, that, in the majority of cases, there is a great excess of fluid.

*b. When such excess is found at operation*, the immediate results of decompression and drainage are exceedingly good. If the operation is conducted under local anæsthesia, and the patient is not too doped to be capable of recognizing conditions and surroundings, he will express himself, at the termination of the operation, as free from the old headache, and on one or two occasions, the patients have sat up on the operation table and expressed themselves in terms of great gratitude. In any case, when seen the day after operation, the answer to inquiry is nearly always the same—the 'old' headache has quite gone, even though it may have existed for one or more years. I am using the term 'old' headache advisedly, because the patient when questioned as to his condition will nearly always say that he has a headache—this, on close questioning, is referred to the site of the wound. The decompression involves a fairly sensitive area and includes some section of the

temporal muscle—in consequence there is often some degree of local pain and discomfort. It is necessary, therefore, to discriminate between the 'old' and the 'new' headaches. The 'new' headache gradually lessens, and in the course of a week or ten days it also goes.

The effect on the patient generally is equally marked—previously dour and depressed, now bright and cheerful, hopeful for the future, dreading the possibility of return of those old and fearsome headaches, hopeful of having cast aside for ever the gloom that previously enveloped him, thankful for the relief given. All this shows that the evacuation of the excess fluid, by decompression and opening of the dural compartment, allows of the immediate relief of the headache.

Confirmation of these facts is gained by a study of the minority cases, operation being conducted in the anticipation that one is dealing with a case of cerebral œdema, but in which, at the operation, little or no œdema is found, and in place of this a slightly weeping, or dry, brain with bulging of the brain into the wound. These cases do not do so well—the headache relief is more problematical, both immediate and permanent. These minority cases obviously come under a different category, and are of a different pathological nature—I think they are examples of ventricular distention, due possibly to chronic meningeal thickening at the base of the brain, interfering with the outward passage of the cerebrospinal fluid.

There is, so far as my experience goes, no definite method of determining which condition is present, cerebral œdema or ventricular distention. The symptoms in the two cases are practically identical. It may be argued that preliminary lumbar puncture would settle the question, but it does not, for in many cases of cerebral œdema lumbar puncture has been negative to cerebrospinal fluid excess. There is no absolute necessity for intracranial excess fluid to be accompanied by spinal excess—it all depends on the conditions in the region of the foramen magnum—whether the communication between the intra- and extracranial systems is free or not. Details as to lumbar puncture in relation to treatment will be considered later.

It is necessary now to consider the origin of this excess fluid. Here difficulties begin. I have argued that as the fluid is chemically, cytologically, and pathologically normal in every respect, that there are only two ways in which to explain the excess: Either it is *formed in excessive quantity and absorbed at an insufficient rate*, or it is *secreted at the normal rate and absorbed inefficiently*.

It is not difficult to determine which hypothesis is more probable. It is only necessary to consider the physiology of cerebrospinal fluid, its origin and course, to advance what is, at any rate, a very plausible theory. It is accepted (*a*) that the fluid is secreted from the choroid plexuses and lining ependyma of the lateral, third, and fourth ventricles, (*b*) that the greater quantity passes up over the surface of the cerebrum, in the subarachnoid space, and (*c*) that it is absorbed at the same rate as it is formed, into the superficial veins of the brain and into the lateral lacunæ of the superior longitudinal venous sinus. This passage of cerebrospinal fluid into the venous system may be the mere mechanical transmission of one fluid of a lower specific gravity and higher pressure into another through a permeable wall, or there may be some selective action on the part of the veins: in all probability the former simple explanation is the correct one.

Now there is a very significant factor present in most of the cases under discussion—a sufficient explanation for the accumulation of cerebrospinal fluid. In the majority of cases of gunshot wounds with brain destruction and subsequent fibrosis, in heat-stroke by its effect on the surface veins in the brain, in cerebral malaria by the plugging and destruction of surface vessels, in the hæmorrhages of injury with brain contusion and laceration—there is in all a common final result: the *loss of a certain percentage of the surface brain area available for the absorption of cerebrospinal fluid*. This fluid, formed at a normal rate, is incapable of being absorbed in corresponding ratio, and in consequence there is an accumulation, shown in the minority cases by a condition of internal hydrocephalus (?), and in the majority cases by the condition of cerebral œdema, of which a description has been given. The fluid collects at the base of the brain, first in the

cisterna, and then accumulates in the meningeal spaces over the surface of the brain, where it is seen at operation.

So far as I can see, the only weak link in my chain of argument lies in the fact that I cannot prove my case at the post-mortem table—the mortality after subtemporal decompression is nil, and I have been unable to prove my contention by microscopical and other evidence.

Are there any other explanations available for this excess cerebrospinal fluid? Is it possible, for example, that they are similar to those described by Warrington[2] as intracranial effusions (serous) of inflammatory origin? Is it possible that the excess fluid is of inflammatory meningeal source? Malaria, heat-stroke, gunshot wounds, etc., might all conceivably lead to some form of chronic meningitis resulting in excess of fluid formation. But, in the cases under discussion, the fluid is always absolutely normal cerebrospinal fluid—there are no extracellular elements, and chemically the fluid is normal in all respects. I do not think, therefore, that these cases are in any respect of inflammatory origin—rather would I accept the view that some of Warrington's cases fall automatically into the group here described.

The theory which I have advanced seems to be best adapted to the conditions as found at operation, and to the results obtained. The other symptoms of the syndrome are all to be explained on the same grounds—the mental depression and uncertainty, the general loss of muscle tone, the exaggeration of knee-jerks, etc., can all be accounted for by the sodden condition of the cerebral cortex, by loss of higher control.

## TREATMENT.

The general lines along which treatment can be conducted in *the milder cases* are simple enough—and moderately efficacious.

1. The patient should be advised to get a light job, preferably out-of-door work, such as poultry-farming, carrier, country delivery of letters, etc., under a considerate employer who will make all allowances for shortcomings, and for days off when the headaches are more incapacitating.
2. Complete abstinence from alcohol.
3. Regularity of bowels.
4. Avoidance of exposure to the effects of heat.
5. The provision of mild narcotics, which are to be taken during the periods of relapse. I prefer aspirin, pot. bromide, and chloral hydrate, of each 5 to 15 grains.
6. The recumbent position in a quiet, darkened room, during the periods of prostration, if any.
7. The avoidance of excitement of all kinds at all times—cinematographs, for example are to be prohibited.
8. The provision of a suitable pension, sufficing to allay the haunting fear of poverty.

Under such conditions, these patients are usually enabled to carry on with reasonable comfort.

*The moderately severe cases* are far more difficult to treat. In spite of rigorous action along the lines indicated above, many cases are quite incapacitated from all work, and it is probable that operative measures, decompression, will be adopted more freely in this type of case—this statement being made in view of the generally satisfactory results of decompression.

On the other hand, all palliative measures should be tried first, and I believe that one of the most important is the provision of a living pension rate. This pension should be permanent; there should be no uncertainty about it, no periodic medical boards, etc.

*In the more severe cases*, after careful consideration of all the circumstances, operative treatment (decompression) can be recommended with considerable confidence.

Of the treatment of headaches by rectal salines,[3] I have but little to say. There is, however, about this method so much obvious impracticability that further discussion is useless. In any case, the benefit is purely of a temporary nature—it does not tackle the root of the disease.

Treatment by lumbar puncture, though objected to on some similar grounds, requires more careful consideration. It is obviously a method of treatment that should be tried, and I have myself submitted it to a thorough test. I have used it so often that I am clear in my mind as to its general uselessness. I would go further, and say that it is also in many cases harmful. I would tabulate my reasons for these general statements as follows :—

1. Cerebral œdema is not necessarily associated with any excess of fluid in the spinal meninges. Whether my views accounting for the excess cerebral fluid are correct or not, there can be no shadow of doubt that the continuity between the cerebral and spinal cerebrospinal spaces is commonly disturbed. Some of my most marked cases of plus cerebral fluid have been associated with minus spinal fluid—all depends on the meningeal conditions prevailing in the medullary region. In cases of marked cerebral œdema there may be such swelling and œdema in that region as to prevent the normal continuity between the two systems.

2. Even if the withdrawal of excess fluid by lumbar puncture brings relief, the effect is purely temporary—fluid collects again within a few hours, and the headaches are again as bad as ever.

3. Lumbar puncture frequently makes the headache much worse. The same effect has been observed in the treatment of cerebral and cerebellar tumours by lumbar puncture. The explanation is difficult, though it is probably concerned in some way with the corking up of the medullary region. I have observed, in some few cases, that the immediate effect of lumbar puncture on a patient suffering from a severe attack of headache has been to throw him at once into a condition of agony.

4. Even if the lumbar puncture brings about temporary relief, the process cannot be continued *ad infinitum*.

In general I am quite opposed to lumbar puncture as a therapeutic measure in these cases. I carry out the measure once, submitting the fluid to chemical, cytological, and bacteriological investigation, and estimating its pressure by spinal manometer. I use Eve's cerebrospinal manometer (*Fig.* 101).

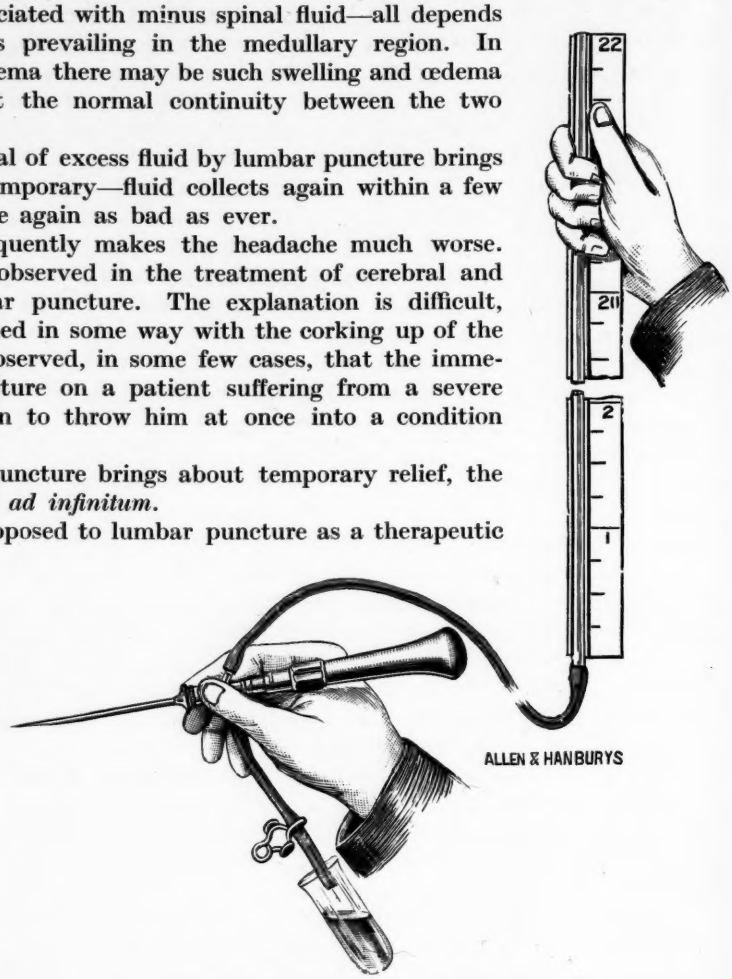



FIG. 101.—Eve's cerebrospinal manometer.

"The instrument consists of three hollow needles of sizes suitable for children and adults, large or small. These fit on to the stalk of a metal Y-piece.

"To the two other branches of the Y-piece are fitted pieces of fine rubber tubing. One tube acts merely as an exit tube by which to draw off the fluid, and the other leads to the manometer. Both pieces of rubber tubing are provided with spring clips, so that the fluid can either be drawn off or diverted into the manometer. A detachable handle also fits on to the Y-piece. This handle is so shaped that it can either be grasped, or held like a pen.

"The three needles are tempered tough, so that the risk of their breaking *in situ* is avoided. It is important always to keep a wire in them except when in use.

"The manometer consists simply of two lengths of glass tubing, uniting by an inch of rubber tubing, and supported in a groove running the whole length of a folding metal scale. The groove is bridged over at intervals of an inch.

"The hydrometer is capable of measuring the specific gravity of small quantities of fluid

(4 drachms). The whole apparatus except the hydrometer is boiled and brought to the bedside in a shallow dish of boiled water. The apparatus is fitted together in accordance with the diagram, and any contained water is shaken out.

"After introduction, the exit tube being already closed by a clamp, the fluid then rises in the manometer, and the pulsations due to the pulse and respirations are seen. If the fluid fails to appear, it may often be coaxed by 'milking down' the rubber tube.

"The pressure is recorded when the zero of the manometer is held at the same level as the needle. If the manometer is held vertical, it shows the pressure of the cerebrospinal fluid in terms of a column of water so many inches high."*

### 2. GIDDINESS AND NERVOUSNESS.

Giddiness, present in 77 per cent of cases, and nervousness, in 68 per cent, though slightly improved under bromide treatment, are both but little benefited by decompression operation. It is necessary, therefore, when carrying out decompression operations for the relief of headache, to make it quite clear to the patient that the two minor ailments, giddiness and nervousness, will be but little improved, if at all. They are both, however, of far less disabling nature than headaches. Plating of the defect of the skull may, in my experience, lessen the general nervous symptoms, but it has little effect on the giddiness.

### 3. PARALYSIS.

It was to be expected that a considerable percentage of the head cases would suffer from permanent paralysis of varying degree. The percentage is less than expected, but quite sufficiently serious (29 per cent). The following table shows the percentage rate according to the nature of the injury incurred :—

| | Per cent |
|---|---|
| Penetrating wounds with hernia cerebri .. .. .. | 46 |
| Penetrating wounds .. .. .. .. .. .. | 35 |
| Penetrating wounds with foreign bodies retained .. .. | 33 |
| Perforating wounds .. .. .. .. .. .. | 32 |
| Fractured base .. .. .. .. .. .. | 21 |
| Non-penetrating wounds .. .. .. .. .. | 20 |
| Scalp-wounds .. .. .. .. .. .. | 15 |

**Penetrating Wounds with Hernia Cerebri.**—In most cases the injury was received over the anterior and lateral aspects of the skull. Patients with occipital and cerebellar herniæ seldom survived; cerebellar cases were especially fatal. When the protrusion involved the motor cortex, hemiplegia resulted, and in many cases the paralysis is of a permanent nature; but it may be added that in some cases the ultimate result was extraordinarily good—the patient recovering almost full power.

**Penetrating Wounds, with or without Foreign Body Retained,** come next in the list of cases presenting permanent paralyses, but it is interesting to note that the retention of a foreign body does not appear in itself to present any additional paralytic disability: 33 per cent with such bodies retained, 35 per cent where none are present, whether removed early or at a later date. In other words, the paralysis results from damage done by the penetration of the foreign body, perhaps increased by attempts at removal, not from the retention of the body itself. This point must not be laboured—no argument against the early judicious removal of foreign bodies is advanced—but it should certainly act as some sort of deterrent against ill-judged and promiscuous attempts at foreign-body removal, both early and late.

**Perforating Wounds,** 32 per cent, come next in the list, the lessened paralytic rate, being due in part to the high death-rate of this class of injury—only the slighter cases recover as a rule, the bi-frontal, etc.

**In Fractured Base, Non-penetrating Wounds, and Scalp-Wounds,** the paralytic rates 21, 20, and 15 per cent respectively, are obviously dependent on brain lacerations and

*I think that, under normal conditions, the fluid rises to a height of 6 to 8 in. When under excessive pressure, I have seen the fluid running from the top of the manometer, i.e., to a height of 24 in.

contusions, surface hæmorrhages, both external to and within the dura mater. It is a debatable point, but one certainly worth consideration, as to whether some of these cases would not have benefited by early operation, with the hope of evacuating extradural or intradural blood-clot (*see* SCALP-WOUNDS, p. 94).

A large number of these paralytic cases have improved under treatment, massage, radiant heat, re-education, etc., but many remain more or less totally incapacitated. The proportionate improvement in upper limb, lower limb, and face has followed the normal course as regards the degree and rate of recovery in the three regions mentioned—face recovering first and most, followed by the lower extremity, the upper always lagging behind. Recovery has been exceptionally poor after injuries of the superior longitudinal sinus—Sargent's longitudinal sinus syndrome.[4]

Allusion will be made later to operative treatment, but it would be wise to state here that plating or closure of the defect in the skull brings about, in my experience, but very little, if any, benefit for this type of case.

#### 4. FITS.

The prevalence of fits after war injuries of the head is of the utmost importance. Early in the war it was stated that the percentage of cases in which fits developed was very low. That also was my experience; but I was sceptical as to whether the picture would not change. In this series, fits were reported in 25 per cent of cases, in the following percentages according to the lesion :—

| | Per cent |
|---|---|
| Penetrating wound with hernia | 54 |
| Penetrating wound | 35 |
| Penetrating wound with foreign bodies retained | 33 |
| Perforating wound | 16 |
| Fractured base | 14 |
| Non-penetrating wound | 13 |
| Scalp-wounds | 10 |

This list should be compared with that illustrating the rate of paralysis in relation to the site and nature of the injury—there is a close resemblance.

**Nature and Frequency of Fits.**—On analysis, it was found that the fits could be divided into four groups, viz. :—

| | Per cent |
|---|---|
| Epileptiform | 57 |
| Jacksonian | 23 |
| Fainting | 16 |
| Slight and uncertain | 4.5 |

It is noteworthy that the more severe types of fit were associated with the more serious lesions. Thus, in non-penetrating wounds there was 1 case of Jacksonian epilepsy, 6 cases of epileptiform seizures, 4 of fainting, and 5 of a slight nature; whilst in penetrating wounds there were 20 cases of Jacksonian and 42 of epileptiform fits, 2 only of the fainting type, and 7 of the slight variety.

The term 'epileptiform' is used for those generalized fits in which there was sudden loss of consciousness, followed by struggling, often of a violent description, and sometimes necessitating restraint with the help of three or four assistants, the patient passing urine involuntarily, biting the tongue, and remaining unconscious for varying periods of time, a few minutes to hours.

The term 'fainting' is used for a type of fit of which I have had little previous experience—a sudden relapse into the dream-state, with no biting of the tongue, etc., enduring a few minutes only, and leaving the patient tired, uncertain as to what has happened, and complaining of severe headache—attacks of petit mal of sorts.

Perhaps these 'fainting' fits, and other types of fit, may be explained by a "vasa-constriction reaction of the minute vessels in the cortex, thus causing anæmia of the brain and, in consequence, a greatly increased sensitiveness to internal and external stimuli, the so-called 'Stokes-Adams' syndrome".[5]

In the treatment of these fit cases, my experience is such that I do not consider operative measures are of much avail, though in some instances the plating of the defect (after Sargent's method) has brought about some benefit. Prolonged and assiduous treatment with bromides, luminal, etc., should be carried out, combined with admission to hospital during the more severe stages. It is remarkable how the condition can be controlled when the patient is properly looked after. This improvement is due, not to the medical treatment of a neurasthenic case, but to the transference of a patient inclined to fits from the economic and family difficulties and exciting incidents of home life to the quiet of hospital, with its systematic and sympathetic treatment, associated with that confidence in the medical man in charge of the case which is so essential.

Luminal, first recommended to me by Sir Frederick Nott, has received a good trial. On the whole, I am inclined to believe that it is the most efficacious drug in fit control, given as a rule in 2½-gr. doses night and morning. I note, in a recent paper,[6] that stress is laid on the establishment of tolerance in patients under luminal, the frequent necessity of dosage increase to obtain control, and the bad effects produced by sudden withdrawal of the drug. I have not noticed these effects myself, though I have recently seen one of my patients under luminal who took five times the dose by accident and who was brought to the hospital in a state of violent excitement closely simulating over-indulgence in alcohol. In any case the drug must be given with caution, its effect carefully noted, and the patients warned against overdose.

### GENERAL REMARKS ON WORK CAPACITY.

I should like to preface this section by a statement to the effect that, of the 400 to 500 cases, there was not a single case in which the patient stated that he could work and could not get work. Whether this applies to the immediate present, I cannot say. My investigations have shown clearly that the slackers are but few in number. Here is a table showing how the men are working, in relation to their wounds and general disabilities.

| | No work Per cent | Light work Per cent | Heavy work Per cent |
|---|---|---|---|
| Scalp-wounds .. .. .. | 10 | 19 | 70 |
| Non-penetrating wounds .. .. | 19 | 24 | 56 |
| Penetrating wounds .. .. .. | 38 | 24 | 38 |
| Penetrating wounds with hernia cerebri | 69 | 20 | 10 |
| Penetrating wounds with foreign bodies retained .. .. .. | 43 | 36 | 22 |
| Perforating wounds .. .. .. | 21 | 26 | 53 |
| Fractured base .. .. .. | 14 | 36 | 50 |

Is it not rather extraordinary that, in the case of penetrating wounds with retained foreign bodies in the brain substance, 58 per cent should work, light or heavy, and that, in perforating wounds, 79 per cent should be earning their living in whole or in part? As another example of the work capacity of these patients, is it not marvellous that one of my patients, with a shrapnel bullet in the very centre of the brain, should be working eight hours a day at pattern-making?

### RETAINED FOREIGN BODIES.

It will be noted that some arguments have been deduced from time to time against the removal of foreign bodies from the brain substance. This statement must be accepted advisedly. All experience shows that the immediate removal of foreign bodies should be encouraged, provided that, in the process of removal, every precaution be taken against increasing the damage already incurred by the penetration into the brain of the foreign body. It is clear, however, that *such bodies may remain encysted in the brain substance without producing any harm whatsoever.* On the other hand, there is some remote chance of a 'flare' (*see* POSTSCRIPTUM, p. 125). These flares, however, are very rare, and it is wise to advise caution in the ranks of the younger generation, as regards the removal of the foreign body, both early and late.

## VIII. DECOMPRESSION, WITH DETAILS OF 40 CASES.

Subtemporal decompression is the routine operation carried out for the relief of headache. This operation has but little, if any, effect upon the other symptoms of the syndrome—giddiness, insomnia, nervousness, etc.—and all my cases of decompression, 40 of which are appended, were carried out with the main object of relieving headache.

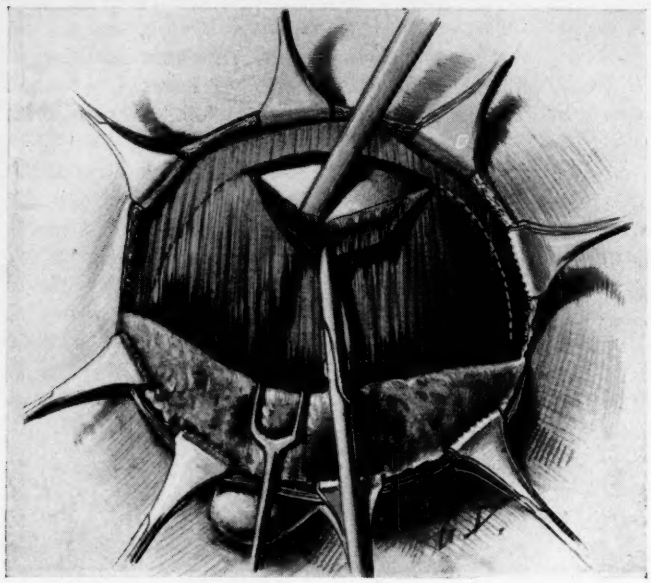


FIG. 102.—Subtemporal decompression. *Stage* 1. Hæmostatic forceps applied to the scalp margin. Temporal muscle incised and stripped from the bone by periosteal elevator.

As regards the rationale of this decompression operation, I believe that in the great majority of cases the headaches are due to increased hypertension, the result of excess cerebrospinal fluid, and that the rational treatment is to trephine over some 'silent' area of the brain, preferably on a level with the base of the brain (for more efficient drainage), in some situation where the scar is inconspicuous and where the osseous defect can be protected with muscle-flap. The excess fluid would be permitted a means of escape into scalp tissues where it is more readily absorbed, the intradural hypertension should be relieved at once, and immediate benefit obtained so far as headache is concerned.

We knew something about 'œdema of the brain' long before the war; but the first of the series of cases on which this paper is based was operated on in India—a soldier from Mesopotamia, invalided to India with fearsome headaches after heat-stroke.

I think I adopted Cushing's method of decompression, the intermusculotemporal route, and this course I have adopted a few times in subsequent cases, usually those of the milder description. It presents some advantages over the method described below, but it does not permit of the degree of exposure required for the necessary brain examination, the field of operation is cramped, and there is always sore risk of damage to the anterior or main branch of the middle meningeal artery, more especially where that vessel runs in a canal or groove in the bone. Consequently, I am accustomed to decompress the temporal region after the following manner:—

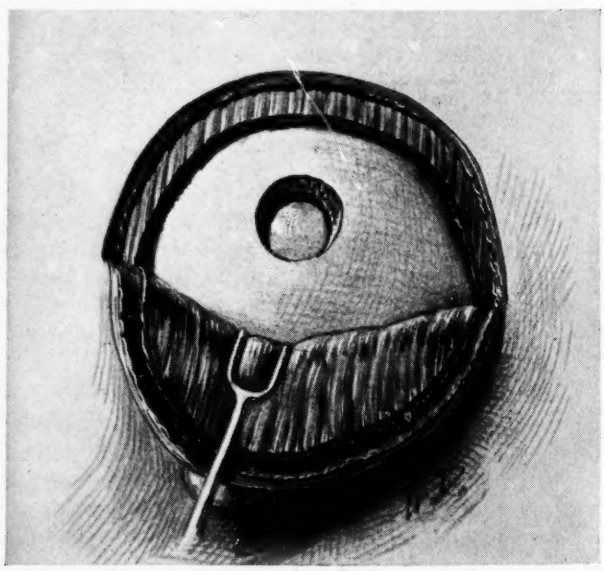


FIG. 103.—Subtemporal decompression. *Stage* 2. Temporal muscle turned down. Bone trephined over centre of exposed area.

The apex of the ear is stitched to the cheek, to get it out of the way, after which a curved incision is made, the convexity of which lies about one inch below the temporal crest, the ends curving downwards as seen in the illustration (*Fig.* 102).

The incision should be commenced at the summit of the curve, and carried down to expose the temporal fascia—about one inch at a time, hæmostatic forceps being applied to either cut edge of scalp, thus obtaining a practically bloodless field. When the incision is completed, the forceps are removed one by one, and bleeding points secured and tied in the ordinary manner.

The skin and subcutaneous flap is turned down for about three-quarters of an inch, when the temporal fascia and muscle are divided to the bone, again at the summit of the wound, about half an inch below the margin of the scalp incision ; the temporal muscle is then seized with Lane's forceps, and the muscle stripped up from the bone with a periosteal elevator, down to the level of the attachment of the ear to the skull, being divided in front and behind with the scissors, in a line with the skin incision. Any bleeding points are secured. The pericranium is stripped away with the muscle. A half-inch trephine is applied to the centre of the bone exposed, and the disc removed (*Fig.* 103). There is no fear of damaging the middle meningeal artery, the trephine area being situated in the angle between its anterior and posterior branches. The appearance of the dura exposed usually shows whether the diagnosis is correct or not, and whether a condition of cerebral œdema is existent or not. In this condition, the dura itself is seen to be œdematous, and to have lost its sheen and translucency. As a rule, moreover, it is not tight nor does it bulge, but pulsation is absent.

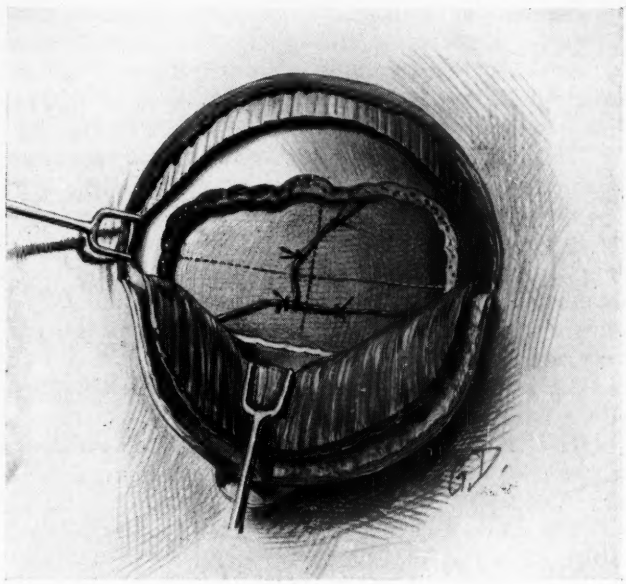


FIG. 104.—Subtemporal decompression. *Stage* 3. Bone cut away in the forward, backward, and downward directions. Ligature of posterior branch of middle meningeal artery and line of dura incision.

N.B.—In practice more bone should be cut away than is represented in the illustration—more especially in front or below, in relation to the retractors.

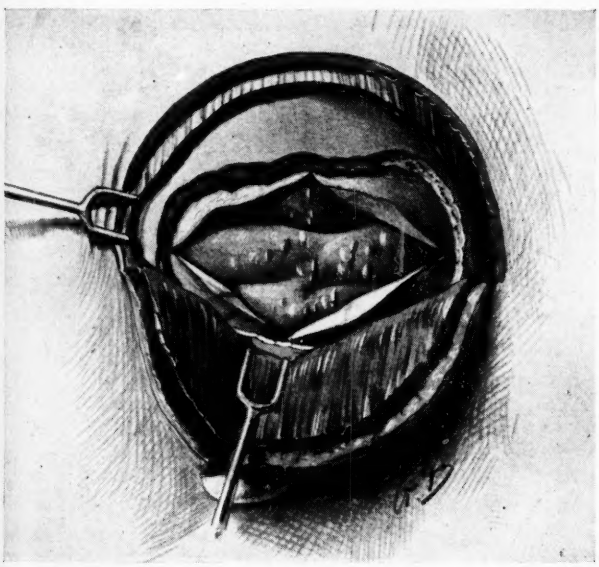


FIG. 105.—Subtemporal decompression. *Stage* 4. Diagrammatic representation of the œdematous and sodden brain, showing the area exposed, and the drainage space provided by the operation.

Before opening the dura mater, the bone is nibbled away, in the forward and backward directions, but more especially in the *downward*, towards the base of the skull and base of the brain,

towards the level of the zygoma and attachment of the ear. The muscle-flap is well held up, and the attached muscle, in front and behind, well retracted so as to allow of the free application of the nibbling forceps, an aperture being framed which is not less than 2 inches in the anteroposterior direction, and 1½ inches in the vertical, the aperture lying throughout underneath the temporal muscle, and reaching down to the base of the skull. When nibbling in the anterior direction, care must be taken to avoid injury to the anterior branch of the middle meningeal artery—the posterior will cross the area of dura exposed, in the horizontal direction.

The lower the aperture is situated, and the nearer to the base of the brain, the more free will be the escape of excess cerebrospinal fluid when the dura is opened.

The posterior branch of the meningeal artery will require ligature in two places before the dura is opened. This is done with an intestinal needle, threaded with fine silk, the needle being passed so as to surround the vessel without injuring the underlying pia-arachnoid. If the point of the needle enters the subdural space, when a condition of œdema is present, fluid will escape through the needle-hole, sometimes in a fine spurt, thus establishing the diagnosis even before the dura is properly opened. The dura is now incised, in a crucial manner, and slit up in the four directions, right up to the margins of the bone aperture (*Figs.* 104 and 105).

If the conditions are as expected, cerebrospinal fluid escapes freely, and a blunt spatula, insinuated beneath the temporosphenoidal lobe, lifting it up, will allow of the escape of more fluid.

The dura is left open. The temporal muscle is approximated with a few catgut sutures, and the fascia sewn up so far as circumstances permit. The skin is sutured with fine salmon-gut, and the wound closed without drainage. The excess fluid escapes into the tissues of the side of the head and face—sometimes leading, in marked cases of œdema, to considerable œdema of the face. This condition soon mends.

The wound is painted over with picric or iodine, and layers of gauze are laid firmly and evenly over the wound.

The stitch is removed from the ear, the ear smeared with ointment, and the dressings are secured with bandages, care being taken to see that the ears are flat, not bent over.

The patient is put back to bed, in the sitting-up position, and kept lightly under the influence of morphia for the first twenty-four hours. The wound is redressed completely the day after the operation.

**General or Local Anæsthetic?**

There are points in favour of either method. The main point in favour of local anæsthesia is related to the question of vomiting—the increase of intracranial pressure associated with the act of vomiting, and the fact that the brain is now unsupported in the region of the aperture, renders it highly desirable that the vomiting element should be eliminated, if possible. There can be no question that vomiting is of less likely occurrence after a local anæsthetic.

On the other hand, there can be no question that the operation can be conducted more freely and more easily under a general anæsthetic, and if complications should arise, for example troublesome bleeding from a meningeal vessel, the difficulties can be overcome more readily.

*Local.*—If the operation is to be conducted at 1.30, the patient at 1 o'clock receives a hypodermic of

| | |
|---|---|
| Morphine .. .. .. .. | gr. 1-4 |
| Atropine .. .. .. .. | gr. 1-100 |
| Hyoscine .. .. .. .. | gr. 1-100 |

and a second hypodermic, same strength, at 1.15.

These injections should be given when the patient is quiet in the anæsthetic room, on the operating table. The eyes should be covered and the ears filled with wool. Then at 1.30 he is wheeled into the theatre and the 'local' anæsthetic given. I am accustomed to use Gray's syringe, with a 2 per cent solution of novocain, freshly prepared, to each

10 c.c. of which are added 5 drops of a 1–500 solution of adrenalin. The solution is injected subcutanously in the line of the proposed incision, and along the base of the flap, blocking the operation field (*Fig.* 106).

I must admit that I was much surprised, when doing my first case under this method, to find that not only was the cutaneo-muscular flap formation painless, but that trephining and enlargement of the aperture were painless also. During the first few minutes of the operation the patient is often nervous, and during the trephining may express some resentment; but I have never heard the patient complain of actual pain. The dural incision is passed unnoticed, as also is digital examination of the brain.

Of course the psychology of the patient must be taken into consideration, and it is desirable to have a skilled anæsthetist present in case his services should be required.

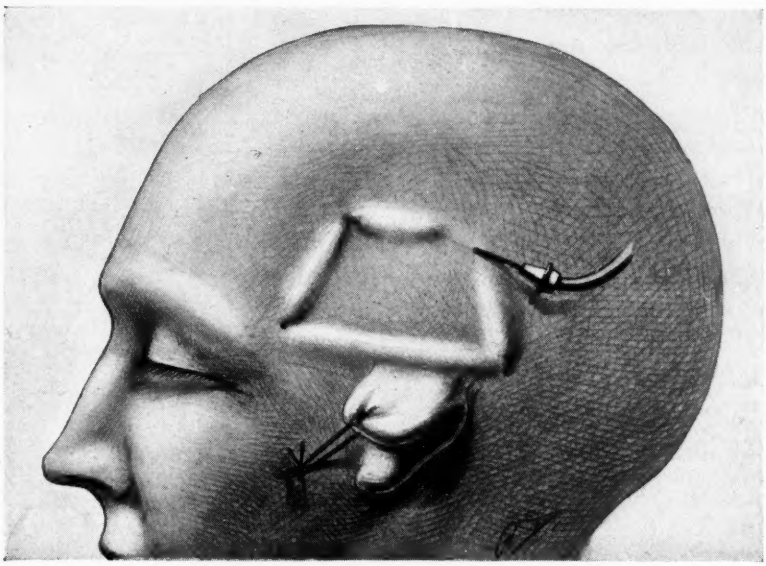


FIG. 106.—Infiltration of the operation area with novocain and adrenalin solution.

As to the *side on which the operation should be carried out*, the right side, in right-handed individuals, is the side of choice, but I never hesitate to operate on the left side—the possibility of interfering with Broca's motor speech area should not arise. I am sure, however, that one should be influenced by any localization of headache—operating on the side on which it is the more severe. Also, it is advisable to operate on the same side as that on which the injury was received.

**After-Treatment.**—It is most desirable that these patients should be kept in bed for not less than three weeks after the operation. This is often very difficult to carry out in practice, for, being relieved of headache after months or years of suffering, patients become very intractable. It is desirable, also, that there should follow a long period of convalescence, at some quiet spot, for three months or more.

**Remote Results of Subtemporal Decompression.**—The immediate benefit, amounting usually to complete relief from the old headache, is dependent on the escape of the pent-up fluid from the intradural space. It would be anticipated, however, that as the wound heals and scarring occurs, the aperture would become closed with scar-tissue, with a return, therefore, of the old headaches. I expected this result—it ought so to be, and to some extent it is so; but not to the degree anticipated. On following up the various cases, two to four years after operation, I have been gratified at the ultimate results in general. There have been some more or less complete failures, and in quite a number the headaches returned again, after a few months, though it is most exceptional for them

at all to resemble the fearful and constant type experienced previously. In some cases the cure is apparently permanent. A complete account with after-results is appended, and it will be noted that the unsatisfactory cases presented very serious primary lesions. In weighing the pros and cons of the operation it should be noted also that the 40 cases reported were the most severe cases of war headache that I have encountered in the last six years.

**Choice of Case.**—The following points should be considered before advising operative procedures :—

1. It matters not how long the headaches may have persisted ; in fact, the longer the more likely the success.

2. Constant headaches, more especially when accompanied by frequent periods of exacerbation—being associated as a rule with marked œdema—are more amenable to treatment than the inconstant cases.

3. The prognosis is better :—

i. When the headaches are accompanied by that facial appearance of depression and misery to which allusion has already been made.

ii. When the patient is 'fed-up' with his trouble.

iii. When marked excess of cerebrospinal fluid is found on lumbar puncture.

iv. When there is no bleeding at operation and no tendency to hæmatoma.

v. When marked cerebral œdema is found at operation.

vi. When the operation is followed by little or no vomiting.

vii. When the patient is able and willing to follow out the after-treatment prescribed.

An analysis of 40 cases of subtemporal decompression shows that the operation was carried out for the following conditions :—

| | | |
|---|---|---|
| Headache following on gunshot wounds of the head | .. | 24 cases. |
| ,, ,, ,, concussion, etc. .. .. | .. | 6 ,, |
| ,, ,, ,, malaria and heat-stroke .. | .. | 3 ,, |
| ,, ,, ,, previous injuries, aggravated | .. | 3 ,, |
| ,, ,, ,, previous fits, aggravated .. | .. | 4 ,, |
| | | 40 ,, |

It is interesting to note that headaches in general, apart from these 40 decompression cases, were associated usually with non-penetrating and grazing wounds of the head, cases in which the primary operation, if any, was of but slight decompressive nature. There was a considerable revulsion of feeling against Sargent's extensive craniectomies in the early stages of the war, but I am quite certain that headaches are of more frequent occurrence in those cases where the surgeon has abstained from operation or carried out a very minor form of bone removal.

This would suggest that, although primary excision of the scalp-wound and primary suture are advisable in general, it is best to carry out also a fairly extensive removal of bone. (*See* below.)

**SYNOPSIS AND CRITICISM OF 40 CASES OF DECOMPRESSION** (*details in Table*).

1. *Cause of Symptoms :—*

| | | |
|---|---|---|
| Secondary to gunshot wound of the head | .. .. .. | 24 cases. |
| ,, ,, concussion | .. .. .. .. .. | 6 ,, |
| Aggravation of pre-existent headaches, due to injury or disease | .. | 7 ,, |
| Secondary to heat-stroke, cerebral malaria, etc. | .. .. | 3 ,, |
| | | 40 |

2. *Operation carried out for the relief of* :—

| | |
|---|---|
| Headache only .. .. .. .. .. .. | 25 cases. |
| Headache and fits .. .. .. .. .. .. | 15 „ |
| | 40 |

3. *Operation* :—

| | |
|---|---|
| Left subtemporal decompression .. .. .. .. | 32 cases. |
| Right subtemporal decompression .. .. .. .. | 6 „ |
| Bilateral subtemporal decompression .. .. .. .. | 2 „ |
| | 40 |

4. *Conditions found at operation* :—

| | |
|---|---|
| Marked œdema .. .. .. .. .. .. | 21 cases. |
| Moderate degree of œdema .. .. .. .. .. | 5 „ |
| Slight œdema .. .. .. .. .. .. | 2 „ |
| Practically no œdema, mainly general tension of the brain, characterized by bulging .. .. .. .. .. | 12 „ |
| | 40 |

5. *Immediate effect of the operation on the headache* :—

| | |
|---|---|
| Very great immediate relief, amounting in most cases to complete relief .. .. .. .. .. .. .. | 30 cases. |
| Improvement, fairly satisfactory .. .. .. .. | 10 „ |
| | 40 |

6. *Remote effect of the operation on the headache* :—

| | |
|---|---|
| Completely free .. .. .. .. .. .. | 4 cases. |
| Slight headaches .. .. .. .. .. .. | 27 „ |
| Moderate and severe headaches .. .. .. .. | 9 „ |
| | 40 |

(Note that operation was only advised and carried out for the very severe cases.)

7. *Remote effect of the operation on the fits* :—

| | |
|---|---|
| Patients who have had no more fits or else fits of quite slight nature | 6 cases. |
| Patients who have fits much the same as before, though in some the fits may be less violent and frequent .. .. .. | 9 „ |
| | 15 |

(I have reason to believe that this relatively satisfactory result has not been borne out by subsequent cases.)

8. *Work capacity of the patient upon whom subtemporal decompression has been carried out* :—

| | | |
|---|---|---|
| Doing ordinary work .. .. .. .. | 17 | 27 = 67·5 per cent. |
| Light work .. .. .. .. .. | 10 | |
| No work .. .. .. .. .. .. | 11 | 13 = 32·5 per cent. |
| Uncertain .. .. .. .. .. | 2 | |
| | 40 | |

This working capacity should be compared with the general average, viz. :—

| | Per cent |
|---|---|
| Scalp-wounds .. .. .. .. .. .. | 89 |
| Non-penetrating wounds .. .. .. .. .. | 80 |
| Penetrating wounds .. .. .. .. .. .. | 62 |
| Penetrating wounds with hernia .. .. .. .. | 30 |
| Penetrating wounds with retained foreign bodies .. .. | 58 |
| Perforating wounds .. .. .. .. .. .. | 79 |
| Fractured base .. .. .. .. .. .. | 86 |

(Note that the 40 cases submitted to decompression operations were previously totally incapacitated.)

*Table II.*—**LIST OF 40 DECOMPRESSION CASES WITH PART**

| Date and Nature of Injury | Symptoms | Operation and Date | Present State as to Headaches | Did Oper... bring Re... | ...and Where... Headache |
|---|---|---|---|---|---|
| Epilepsy and headaches since 7 years old. Aggravated by service in Mesopotamia | Severe epileptic fits, with constant and severe headaches | Left subtemporal decompression, Sept., 1916. Œdema slight | Slight occasional | Yes | ...stly at nig... |
| Epilepsy and headaches since childhood. Aggravated by service in Gallipoli and Mesopotamia | Severe epileptic fits, with prostrating headaches | Left subtemporal decompression, Sept., 1916. Marked œdema | Slight occasional | Yes, ... satisf... | ...nings, fro... |
| Depressed position of vault in 1911. Headaches, previously slight, became much aggravated by service in Mesopotamia | Persistent headaches, with periodic prostration. Insomnia. Occasional vomiting | Right subtemporal decompression, Nov., 1916. Marked œdema | Occasional severe, generally slight and inconstant | At first... Now, ... good | ...gs, on ... ...pecially i... ...avy weat... |
| Previous history of fits and headache, much aggravated by service in Mesopotamia | Severe and prolonged fits. Persistent and severe headaches. Periodic prostration | Right subtemporal decompression, Jan., 1917. Marked cerebral œdema | No headaches | Yes | — |
| Meningitis(?) when 14. Life miserable. Worse after service in Mesopotamia | Chronic and persistent headaches, with exacerbations | Left subtemporal decompression, Jan., 1917. Marked œdema | None | Quite s... | — |
| (?) Heat-stroke, (?) Cerebral malaria in Mesopotamia | Violent epileptiform fits, severe headaches, often with prostration | Left subtemporal decompression, Feb., 1917. Some œdema, marked general bulging | None | Yes | — |
| G.S.W. Mastoid, Dec., 1916, depressed, non-penetrating | Persistent headaches | Left subtemporal decompression, April, 1917. Œdema well marked | Severe at times | Somewh... ter th... fore th... ation | ...emple, esp... ...work and... |
| Heat-stroke, 1915, in Mesopotamia | Violent epileptiform fits, with severe and persistent headache | Right subtemporal decompression, August, 1917. Marked tension, but little œdema | At times | Yes, g... first. not so | ...n the mo... ...te in the... |
| G.S.W. Left frontal, penetrating, June, 1917 | Very severe and constant headache. Severe exacerbations | Left subtemporal, Dec., 1917. Marked œdema. Right subtemporal, Oct., 1918. Less œdema | Varying from very slight to moderate, inconstant | Consi... relief... first ... tion, ... after ... second | ...gs, and aft... ...ient and v... |
| G.S.W. Frontal, non-penetrating, Oct., 1917 | Persistent headaches, with exacerbations | Left subtemporal, March, 1918. Œdema moderate | Slight occasional | Yes | ...gs in th... ...e |
| G.S.W. Left temporo-parietal, removal of bullet from brain, Feb., 1917 | Headaches, aphasia, hemianopsia. Fits | Removal of bullet, March, 1917. Left subtemporal, March, 1918. General bulging | Slight occasional | Lessenin... headach... giddine... | ...mer, acro... |
| G.S.W. Left temporal and occipital regions, severe brain laceration and numerous small foreign bodies remaining in brain | Violent headaches, with screaming fits. Streptococcal meningitis. | Right subtemporal, April, 1818. General bulging | Great relief at first, then recurrence, and now better again | Yes | ...g and nigh... ...n region... ...l |
| G.S.W. Left temporal, July, 1916, with laceration of brain | Constant headaches, with occasional epileptiform fits. Dull mentally. | Left subtemporal, May, 1918. General œdema | Slight occasional | Instant... | ...tram, an... ...gs, and i... ...er |
| G.S.W. Fronto-parietal, ? penetrating, 12/4/18 | Very severe and constant headaches, with exacerbations | Left subtemporal decompression, 31/5/18. Moderate degree of œdema | Occasional | Yes | ...emporal ... ...exertion |

**H PARTICULARS AND END-RESULTS.**

| AND WHERE ARE HEADACHES? | ANY OTHER COMPLAINTS? | ANY FITS? | WORKING? | REMARKS FROM PATIENTS | CONCLUSIONS |
|---|---|---|---|---|---|
| stly at night | None | None | Labourer | —— | Good result |
| rnings, frontal | None | None | Grocer | "I feel practically as well as as when I left England" | Good result |
| s, on getting pecially in dull eavy weather | None | None | Railway carriage cleaner | "I was sent to France in 1918, which did me no good. Now much better again" | Good result |
| —— | Giddiness | Occasional slight | Provision trade | "At times all right, but after excitement get my headaches again" | Fair result |
| —— | None | None | Commercial traveller | "Instant relief, and all right so long as I wear a protector over the hole" | Good |
| —— | None | None | Farm hand | "Quite well" | Good |
| emple, especially work and worry | Depressed | None | Light engineering | "Not so strong as I used to be, and memory bad" | Moderate |
| n the mornings, te in the even- | None | None | None | "Very susceptible to changes of weather, especially moist heat" | Moderately good |
| s, and after ex- ent and worries | Sleepless at times and nervous | None | Light farming, but very little | "Better and improving" | Fairly good |
| s in the left e | None | None | Army Pay Office | "In good health, headaches not worth worrying about, and sleep well" | Good |
| mer, across the | None | Two fits only | Electric railway | "Not satisfied" | A very severe case, results satisfactory on the whole |
| g and night, but in region of i | None | Two fits | None | —— | Result good, in consideration of nature of injury |
| tram, and bus ys, and in hot er | None | None | Trying to get work | —— | Good |
| emporal region, exertion | None | None | Motor-driving | "I don't think I should be writing except for your work. The horrors of those old headaches sometimes come back to me" | Good |

*Continued on next page*

*Table II.*—**LIST OF 40 DECOMPRESSION CAS**

| Date and Nature of Injury | Symptoms | Operation and Date | Present State as to Headaches | Did Op… bring R… |
|---|---|---|---|---|
| Concussion in 1905, headaches frequent, and aggravated by service in India, 1916–1917 | Constant headaches, with frequent and violent exacerbations. "No interest in life." Some fits | Left subtemporal decompression, 15/8/18. Marked cerebral œdema | More or less constant | "Not … |
| G.S.W. Right occipital, penetrating, 18/4/18 | Constant headaches and apathy | Left subtemporal decompression, 30/8/18. Very marked œdema | Slight occasional | Ye… |
| G.S.W. Right frontal, penetrating. Date ? | Constant headaches, with exacerbations. Depression and fits | Left subtemporal decompression, 10/11/18. Marked œdema | Slight occasional | Ye… |
| G.S.W. Occipital (Palestine), 29/11/17. ? injury to brain | Severe and persistent headaches, bi-temporal, culminating at vertex | Left subtemporal decompression, 5/10/18. Moderate degree of œdema | Slight occasional | Ye… |
| G.S.W. Right frontal, 3/10/18 No operation | Apathetic and listless. Continuous headache, usually very severe | Left subtemporal decompression, 19/10/18. No œdema, bulging only | Slight occasional | Ye… |
| G.S.W. Right parieto-occipital, with extradural hæmorrhage, and with foreign body remaining in right occipital lobe, 28/7/18 | Constant headache, with periods of vomiting. "Wake up with it, and go to bed with it." Jacksonian fits | Left subtemporal decompression, 1/11/18. Marked œdema. | Slight constant | "I fe… for th… tion, … did m… of goo… |
| G.S.W. Right parietal, penetrating, in Mesopotamia, 8/11/17 | Constant headache, with frequent prostration | Left subtemporal decompression, 7/11/18. Marked œdema | Slight occasional | Ye… |
| Concussion, (blown up), 14/8/18 | Constant headache, with periods of prostration | Left subtemporal decompression, 14/11/18. Marked œdema | Slight occasional | Ye… |
| G.S.W. Left mastoid, penetrating, and fracture of base of skull | Constant headaches | Right subtemporal decompression, 22/11/18. No œdema, marked bulging | Slight occasional | Ye… |
| G.S.W. Right parietal, non-penetrating, 9/9/18 | Constant headaches, with periods of severe exacerbation | Right subtemporal decompression, 7/12/18. No œdema, some bulging | Slight occasional | "Yes, … tion … great … |
| G.S.W. Right orbito-frontal, penetrating. Date ? | Constant headaches, dull mentality, with frequent exacerbations | Left subtemporal decompression, 19/12/18. Some œdema, some bulging | Occasional | "Not … as … operati… |
| G.S.W. Frontal, penetrating, Dardanelles, 12/8/16 | Headaches commenced in 1917, gradually becoming more severe. Weakness of left leg | Left subtemporal decompression, 27/12/18, with marked œdema | Slight occasional | Ye… |
| G.S.W. Left fronto-parietal, penetrating, 17/7/18 | Constant dull headache, never free | Left subtemporal decompression, 1/2/19. Marked œdema | Very slight, constant | Ye… |
| Blown up, depressed fracture left frontal, dura intact, 24/11/17 | Constant headaches, with exacerbations | Left subtemporal decompression, 12/9/18. Some œdema, but marked bulging | Constant slight, severe occasionally | "Some … but … much … ticipat… |
| Head-injury in Mexico, 1916. Headaches and fits since, aggravated by service in France | More or less constant headaches. Mild epileptiform seizures | Left subtemporal decompression, 15/4/19. Marked œdema | Severe occasional | "Oper… success… far as c… headach… concern… |

**H PARTICULARS AND END-RESULTS**—*continued.*

| ND WHERE ARE HEADACHES? | ANY OTHER COMPLAINTS? | ANY FITS? | WORKING? | REMARKS FROM PATIENTS | CONCLUSIONS |
|---|---|---|---|---|---|
| es one side, at the opposite | Depression. Malarial attacks | ? Jacksonian epilepsy, right | Light and occasional at wool and cotton mill | — | Rather moderate |
| no specified | None | None | — | — | Good |
| — | None | One fit | Returned to Australia | — | Good |
| e, sides and top d | None | None | — | — | Moderate |
| nding, or after on, across eyes | None | None | Railway | "Never felt better" | Good |
| evere' weather, or cold, in left e | "Do not feel as well as soon after my operation" | Two fits | — | "Immediate results were good, but I have gone back" | Moderate only |
| es of weather | Malaria | None | None | — | Fairly good |
| work brings on ches, at other well | None | None | Locomotive | "Improving" | Fairly good |
| ry weather, and excitement | Facial paralysis, left | None | Coil-winding | — | Fair only |
| weather, rushing , in temple | None | None | Motor mechanic | "Since operation my head has not given me half the trouble which existed before. I seem to be brighter and better" | Fairly good |
| l, on bending | Insomnia | None | Part-time, pit-bank | "In the pink one minute, and down in the dumps the next" | Fairly good |
| gion of wound, special exciting e, except walking, ing | None | None | — | — | Fairly good |
| l, especially when uncovered | Depression | None | Light work | — | Fairly good |
| ntal region, when ing and on exer- | Depression | None | Delivering letters, three hours | — | Fairly good |
| gion of operation, excitement and on ing | Insomnia | One a month | Chauffeur | — | Good |

*Continued on next page*

*Table II.*—**LIST OF 40 DECOMPRESSION C PART**

| DATE AND NATURE OF INJURY | SYMPTOMS | OPERATION AND DATE | PRESENT STATE AS TO HEADACHES | DID BRIN | ND WHERE EADACHES |
|---|---|---|---|---|---|
| G.S.W. Frontal, fissured, July, 1915. Returned to France, headaches commencing May, 1918, and gradually getting worse | Persistent headaches | Left subtemporal decompression, 24/3/19. Very marked œdema | Frequent headaches, though better | " Sti tim | n of oper |
| G.S.W. Left frontal, penetrating, 26/4/17 | Headaches, varying from 'slight' to 'awful' | Left subtemporal, 24/3/19. Some œdema and some bulging | Occasional | | y exertio |
| Fractured base, 21/12/18 | Headaches. Dull mentality | Left subtemporal, 1/5/19. Moderate degree of œdema | Occasional | | — |
| Concussion, after mule-kick, occipital, 10/4/19 | Constant headaches, dull and apathetic | Left subtemporal, 29/5/19. Very marked œdema | Slight occasional | " Sti ing full har me sam | — |
| Epilepsy since 7 years, aggravated by service | Frequent fits, severe headaches, both becoming worse | Left subtemporal decompression, 30/4/19. Marked œdema | No headaches | Yes, | — |
| G.S.W. Left occipital, penetrating. F.B. removed from right parietal region, followed by hernia cerebri | Very severe headaches, general convulsions, papill-œdema. Streptococci in cerebrospinal fluid | Left subtemporal decompression, 15/3/19. Little œdema | Constant headaches | Littl | General |
| Blown up, concussion 26/1/15 | Constant headaches, with numerous epileptiform fits | Left subtemporal decompression, 20/6/19. Moderate degree of œdema | Occasional slight headaches | | ver eyes |
| G.S.W. Left parieto-occipital, May, 1916 | Severe headaches, dulled brain, ventriculitis and right hemiplegia | Left subtemporal decompression, 13/12/19. Much bulging and little œdema | Frequent and severe | | to-occipit |
| Concussion, March, 1919 | Very severe headaches, apathetic and depressed | Left subtemporal, 20/11/19. Very marked œdema. Right subtemporal, 18/12/19, less œdema | Occasional, slight to moderate | " Yes imp | — |
| G.S.W. Left parieto-frontal, penetrating, 12/4/18 | Severe and persistent headaches, with exacerbations, dull mentality | Left subtemporal decompression, 31/5/18. Marked œdema | Occasional | " Y bett | Frontal |
| G.S.W. Left frontal, non-penetrating, 15/5/18 | Frequent headaches, dull and apathetic | Left subtemporal decompression, 27/10/19. Some œdema, some bulging | Very slight | " Yes still ing | Frontal |

## IX. CLOSURE OR PROTECTION OF THE GAP IN THE SKULL.

In discussing this question, two main points arise : (I) *What is the object of the procedure, what is it done for ?* (II) *What is the best method of closing or protecting the aperture in the skull ?*

**I. The Objects of the Procedure.**—These are three in number :—

1. To relieve the psychological effects produced on the patient by the mere fact that he has a hole in his skull. Can they be remedied by operation ?

2. To afford some means of protection of the gap from further external injury.

**PARTICULARS AND END-RESULTS**—*continued.*

| ND WHERE ARE HEADACHES? | ANY OTHER COMPLAINTS? | ANY FITS? | WORKING? | REMARKS FROM PATIENTS | CONCLUSIONS |
|---|---|---|---|---|---|
| n of operation | None | None | —— | —— | Moderate only |
| y exertion | None | None | Odd man at farm work | —— | Fair |
| —— | None | None | —— | —— | Fair |
| —— | None | None | Light farm work | —— | Good |
| —— | —— | Occasional, lasting 2 minutes | Light gardening | "Much better since my operation. The fits do not worry me as of old, and they are less frequent, and not so severe" | Good |
| General | Weakness of left side | Occasional epileptiform | —— | "Very little better, life saved only" | Bad |
| ver eyes | —— | None, since operation | Traveller in cloth | "You found out about my head more in a few hours than what it took many doctors months—and also removed my trouble, what the others could not do" | Good |
| to-occipital | —— | Occasional slight | House-work | "Hope to go to Canada soon" | Fair |
| —— | —— | —— | —— | —— | —— |
| Frontal | —— | —— | Attendant at a London hospital | "Never get those terrors of headaches, and I should not be writing this except for you" | Good |
| Frontal | —— | —— | Tennis-racket stringing | "Am very satisfied" | Good |

3. To relieve the patient of certain symptoms associated with, and dependent on, the injury, more especially headaches, fits, and paralyses.

1. *Psychological.*—The mere fact that a man has a 'hole in his skull' may bring about marked psychological effects, more especially when the defect is of considerable size, situated over the more conspicuous parts of the head, covered by a scar overlying a pulsating brain, and depressed below the surface contour of the skull—as so many of these injuries are.

The patient may feel the defect both literally and metaphorically, worrying himself about it, fingering it, and imagining all sorts of terrible after-results. Such defects render

the patient supersensitive to observation, and he may be desirous of operation on purely psychological grounds.

Such patients form but a small group, but it is possible that an operation so planned as to render the deformity less obvious may bring about quite satisfactory results, more especially when the injury is situated in the frontal region. Silver and celluloid plates, applied in the manner described below, may benefit the patient, but all such methods present one obvious disadvantage—there is unquestionably a definite tendency for all such plates to assume, as time progresses, a degree of concavity to the surface, the result of atmospheric pressure—there is, as a rule, a shrinkage of the brain in immediate relation to the defect of the skull, and the plate gives to the external pressure, bending inwards towards the brain. This results in a concavity of the plate, and frustrates the object desired. Bone-plates will be more satisfactory in this class of case, and I regard the purely psychological cases as the only indication for bone-grafts.

In other words, when the patient is influenced solely by psychological effects, the aperture may be closed in, if otherwise desirable, with a bone-graft. All other methods are liable to fail, with corresponding disappointment to the patient.

2. *Protective.*—When a patient with a gap in his skull suffers from nothing more than a fear of possible injury, some form of plating may be desirable to strengthen the injured region. These cases are very few in number, and I do not remember more than two or three coming to me with that specific complaint. In such cases I think the double celluloid plate method will suffice, on the ground that no method, even bone-grafting, is really protective against any serious direct injury to the region, and the celluloid method is sufficiently efficacious and quite simple.

3. *Symptomatic.*—The more important remote effects of gunshot wounds of the head, where a defect in the skull remains, may, so far as symptoms are concerned, be divided into two groups, a major group where the injury is followed by severe, often persistent, headaches, fits, and paralyses, and a minor group where irritability, insomnia, giddiness, and nervousness are predominant. It having been stated elsewhere that closing in or protecting the gap in the skull may improve the conditions specified, it is necessary to examine the question carefully, in the endeavour to arrive at some definite conclusion as to the degree, if any, to which the patients have benefited.

Firstly, I would ask these questions: Can any of the conditions enumerated be regarded as dependent, in their incidence and progress, on the mere presence of some osseous defect? At first sight, it would appear highly improbable that any of these symptoms could be explained on this hypothesis, and that they could be remedied by closure or protection of the aperture. There is, I think, but little doubt that that is a correct representation of the case. But there are some few cases in which operation is really beneficial. There are some patients who suffer from slight infrequent headaches, who sleep badly, who suffer from very slight epileptiform or fainting attacks, who are depressed and nervous—cases, in other words, of the mildest forms of after-effect. The closure or protection of the aperture of the skull, in such cases, often brings about great benefit—though it is possible, according to my mind, that this is mainly due to the psychological effects of the operation.

In consideration of the more serious symptoms, severe headaches, etc., the headaches are due, as explained previously, to a condition of cerebral œdema, for which decompression is indicated as the rational treatment—not the closure or protection of the skull defect.

The various paralyses are due to tract degeneration, and plating, etc., cannot lessen the degree and extent of the paralyses. The fits, too, are as a rule secondary to cortical scarring and degeneration, and gap protection cannot lower their incidence. Nervousness, insomnia, giddiness, etc., are not of psychological origin; they form part of the syndrome of cerebral œdema, and are due, I think, to the soaked, sodden state of the cerebral cortex. At first sight, therefore, one would be inclined to accept the view that closure or protection of the gap in the skull could not bring about any appreciable benefit along the lines indicated.

But the question is not quite so simple. Fits, for example, may be brought about by adhesion of the brain to the overlying scalp scar, and it is clear that the interposition of plates (*see below*) between the scalp and the bone, merely separating brain from scalp, is not infrequently beneficial, sometimes markedly so.

Again, I would lay considerable stress on Sargent's theory—that in penetrating wounds of the brain, the dura mater becomes adherent to the margins of the osseous gap, and that the brain is adherent in the immediate vicinity of the site of dural injury to the dura itself, and, in consequence, that the brain is more or less 'anchored' to the region of the scalp and bone injury. There is, under normal conditions, a certain degree of mass movement of the brain, a certain amount of give and take on the part of the brain to rapid movements of the head, and any 'anchoring' of the brain may assist in the development of fits by local irritation, in the advent and persistence of localized and general headaches by reason of the local and spreading œdema, in the development of giddiness, etc., by lowering the general cerebral stability, etc. In view of these theories, Sargent has advanced a method of plating, referred to later, which has as a definite object the freeing of the adherent dura, the 'un-anchoring' of the brain (I apologize for the use of this term), and the prevention of further adhesion in that region. It would appear, therefore, that there are some points to be advanced in favour of closure or protection of the gap in the skull from the point of view of relief of some of the remote symptoms. Acting on Sargent's theories, I have plated defects on many occasions with, on the whole, satisfactory results. Further details will be given later as to the advantages and disadvantages of this method.

Taking the question, then, as a whole, one would be inclined to conclude :—

1. That, in the event of severe headaches, with exacerbations and prostrations, cerebral œdema being in most cases the causative agent, plating is useless. Decompression is required.

2. That, in the event of hemiplegia, or paralysis of corresponding magnitude, plating brings about no benefit.

3. That, in the event of severe Jacksonian fits, of epileptic or epileptiform fits, little benefit is likely to accrue from closure or protection of the gap with bone-plates or other plates.

But when the headaches are mild and inconstant, more especially when limited to the immediate vicinity of the wound, when the fits are slight, generalized and slight, or Jacksonian and slight, and when one or both of these conditions are associated with insomnia, trepidation, and giddiness, then I believe that with plating or closure of the defect, along the lines suggested by Sargent, there is a fair probability of amelioration.

The plating question has to be considered most carefully. I have seen cases which have been plated both by myself and other surgeons where, although the immediate results were satisfactory, after a few months the old troubles returned, sometimes more forcibly than previous to the plating. And I have removed the plates in some few of the cases with immediate relief of all symptoms. In these cases, where plate removal was necessitated, the patients had complained of a great feeling of weight, of oppression in the region of the wound, with vague neuralgic pains, radiating from the plate but usually centred at some part of its circumference, often in the line and distribution of some sensory scalp nerve.

In general, my present opinion on plating, of all types, so far as indications and results are concerned, is as follows :—

1. From the point of view of psychological effects, operation, closure, or protection of the aperture is of some, but limited, benefit.

2. From the point of view of protection, the operation is of considerable benefit.

3. From the point of view of symptomatic relief, the operation may be of definite value when carried out in the type of case indicated, but is disappointing in general, more especially when conducted for the relief of severe and more or less constant headache, of fit cases of the more severe type—whether generalized or Jacksonian—and of paralyses.

**II. What is the Best Method for Closing or Protecting a Gap in the Skull ?—**

The various methods that have been adopted, both previous to the war and subsequently, may be divided into two groups : (1) *Autogenous bone-grafts*, to close permanently the gap in the skull. (2) *Plating of the defect*, together with other procedures on the lines of Sargent's theories. (*Fig.* 107.)

1. BONE-GRAFTS.—I have stated previously that I do not like bone-grafts for the skull. I will admit at once that I have not used this method myself, and therefore my opinions are not based on practical experience, but I have considered their advantages and disadvantages, their merits in a general sense, and I have seen about a dozen cases in which this method of skull protection has been carried out. I do not like the principle, nor do I like the results as seen in these few cases.

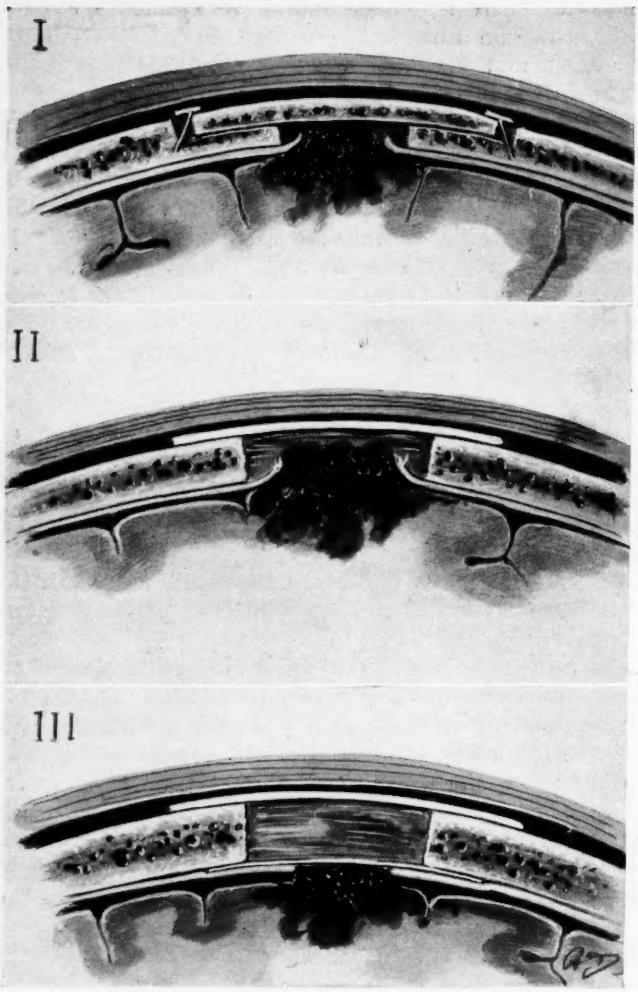



FIG. 107.—To illustrate three methods of protection or closure of defects in the skull : (i) By bone-graft ; (ii) By silver plate, between scalp and bone ; (iii) By two celluloid plates, an inner thin smooth plate between bone and dura, an outer perforated and stronger place between scalp and bone.

So far as principles are concerned, I have already pointed out that, so far as my personal experience goes, the benefit attained by closure or protection of the aperture in the skull by any method is very limited in practice ; that it ought not to be adopted with the idea that any considerable improvement, in respect to fits, headache, and paralyses, is likely to accrue ; and I would add further that, in my opinion, the complete closure of the gap with a bone-graft which is expected permanently to close in the defect, is wrong in principle. It may be useful when the gap alone is the trouble, where the patient is perfectly well except for the hole in his skull ; but such cases are relatively few in number, almost negligibly so : the great majority suffer, to a greater or less degree, from those other remote effects mentioned previously, all due to intradural changes, whether excess fluid, adhesions, or degenerations. To pay all attention to permanent closure of the gap, and to neglect the far more important intracranial changes—to dam up excess fluid, for example—is, in my opinion, entirely wrong in principle.

In further reference to bone-grafts, I have observed, in the cases that have come under my care, that the results obtained have been poor. Further, I am not convinced that the grafts will remain as bone-grafts—the skull is a poor place for bone-growth in general, and in two or three cases that I have seen, the graft died, leaving a plate of dead

bone exposed to the surface through sinuses discharging pus—the graft being removed subsequently with considerable difficulty.

My arguments are undoubtedly weakened by the fact that I have no actual experience of bone-grafting in the skull, but I believe I am right in principle and practice.

2. PLATING OF THE DEFECT.—Following Sargent in his theories and practice, I am accustomed to adopt the following procedures—described as briefly as possible.

*Material used.*—Celluloid plates, two in number, the one (the outer plate) perforated, $\frac{1}{500}$ in. thick, the other (the inner plate) smooth, $\frac{1}{1000}$ in. thick. These plates are bought in sheets and can be cut readily to the size desired.

*Sterilization of the Plate.*—The fresh celluloid, cut to a convenient size and shape (*Fig.* 108), is washed in running water, scrubbed with soft soap and water, rinsed again in running water, then wiped over thoroughly with methylated spirit, wrapped in sterilized gauze, and put away till wanted. When required, the celluloid is placed in sterilized water, and previous to insertion is rinsed in spirit, then washed again, after which it can be used. Immediately previous to insertion, the plate is picked up with forceps and cut to the size and shape required.

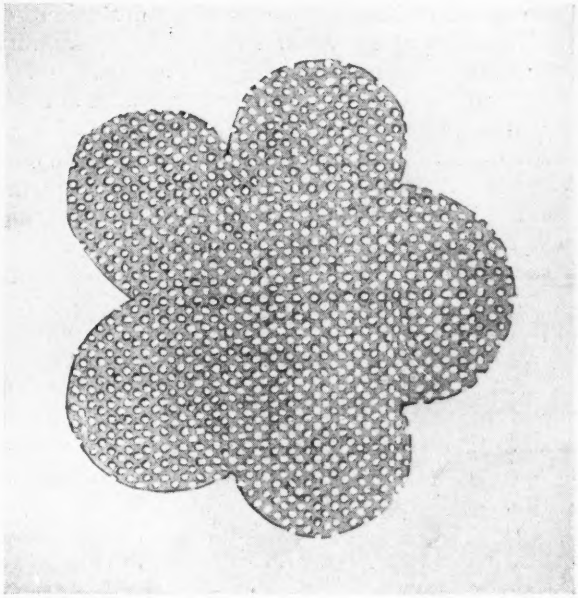


FIG. 108.—Closure or protection of apertures in the skull. The thicker outer perforated celluloid plate for insertion between scalp and bone: this plate is trimmed to some such shape as is represented in the illustration, for ready insinuation underneath the scalp.

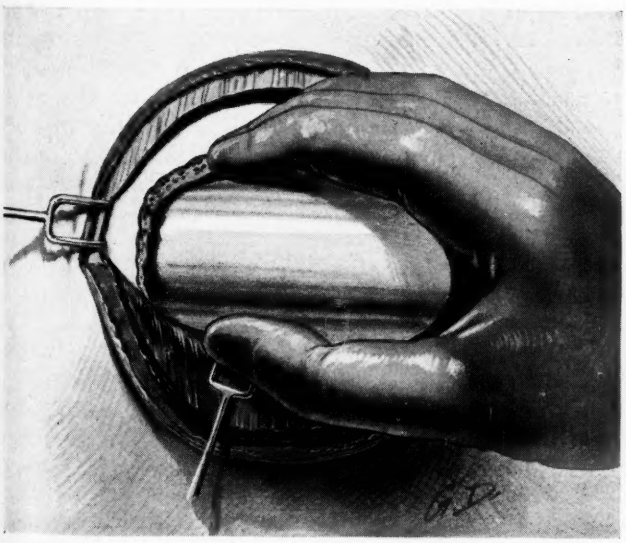


FIG. 109.—Closure or protection of apertures in the skull. The introduction of the inner thin celluloid plate; insinuation of the plate between the dura and the bone edge.

The thicker perforated plate will lie between the bone and the scalp — protective — whilst the smooth plate will be used between the dura mater and the bone, after the 'un-anchoring' of the dura mater from the margins of the aperture.

*Method of Introduction.*—Under general anæsthesia—the head being enveloped in gauze sheet to avoid contact with the patient's skin—a flap is turned down, the whole thickness of the scalp, completely exposing the defect in the skull. This scalp incision lies one-eighth to three-quarters of an inch distal to the margins of the aperture in the bone. Some part of the scalp-flap may be merely scar-tissue, adherent to the tissue immediately underlying the gap, and great care must be taken, when turning down the

scalp-flap, to avoid button-holing the flap. All surface tissue must be included in the scalp-flap by clean dissection—even at the expense of the underlying dura, torn dura, or scar-tissue—this should be avoided whenever possible. Bleeding is controlled with the scalp tourniquet, or by means of hæmostatic forceps.

*Insertion of the Inner Plate.*—The pericranium is incised with a fresh scalpel, about half an inch distal to the margin of the gap, and stripped with Farabeuf's raspatory to the margin of the aperture. There it becomes adherent to the edge of the bone, to which also the dura mater is adherent in the case of a penetrating wound. With the raspatory insinuated around and beneath the osseous deficiency, the dura mater and pericranial fringe are detached from the margins of the gap, after which a flat periosteal elevator is inserted so as to strip the dura from the overlying bone for a distance of not less than one inch throughout the whole circumference of the gap. This being completed, the ragged tissue in the centre of the field is dissected away with a sharp scalpel, leaving a surface as smooth as possible, without cutting into the surface of the cortex exposed. It is important in every case to avoid injury to cortical vessels, venous sinuses, etc. This must be carried out with circumspection, a dry field remaining.

All is now ready for the insertion of the inner, smooth plate, between the bone and the dura mater (*Fig.* 109). If, however, the bone edges are ragged they should be smoothed with nibbling forceps, it being the general object to leave an oval opening in the bone—the plates are then introduced with ease. The thin celluloid is trimmed with scissors to correspond to the size and shape of the aperture, being about one-third of an inch larger in all diameters. It is bent or doubled so as to slide and be inserted beneath the bone, lying there snugly, overlapped by the margins of the gap throughout its circumference.

*Insertion of the Outer Plate.*—The scalp having been separated from the bone for a distance of about two inches peripheral to the margins of the gap, the thicker celluloid is trimmed with the scissors, with such snips here and there as will allow of the snug fitting of the plate to the convexity of the skull. The plate should overlap the margin of the aperture in the skull by not less than one inch, the edges of the plate being guided beneath the scalp—so as to overlie the gap and be overlapped by the scalp. When lying smoothly, the scalp-flap is replaced and anchored by many fine salmon-gut sutures, without drainage. Dressings and bandages are applied carefully, with the object of exercising an equal pressure throughout the wound area, thus avoiding the development of a hæmatoma.

Having been compelled to remove celluloid plates on some few occasions, twice for sepsis, and a few times because of recurrence of headache, etc., it is interesting to note how the two plates work. With respect to the septic cases, I would urge that if the temperature of the patient after operation suggests that possibility, and when the wound, on inspection, suggests the presence of a hæmatoma, it is wise to act promptly, turning down the flap and removing both plates. This is readily effected in the early stages. In one case, blood external to the outer plate was sterile, whilst the blood between the two plates grew pyogenic organisms. In the other case, nothing grew, but the hæmatoma was of considerable size, and I think I acted judiciously in removing both the plates.

When the plates are removed at a later date—months after the insertion—the following conditions were found. The outer plate was firmly anchored in position (being removed indeed with some difficulty) by strands of fibrous tissue, which had passed through all the small perforations of the plate, from scalp to bone and pericranium, except over the immediate region of the aperture itself, where the strands passed from the scalp into the perforations of the plate; but when the plate was removed and looked at from the under surface it could be seen that where the outer plate had come into 'approximation' with the inner plate it was smooth, lined with an endothelial membrane, and no strands of fibrous tissue had here passed through the perforations.

The inner plate was equally interesting. It fulfilled its purpose admirably; that is: (1) It was non-irritating, as proved by the fact that, after having been in position for some months, it could be lifted off from the surface of the brain or dura with the greatest ease, with no sign whatsoever of fibrous tissue development; and (2) It had prevented

'anchoring' of the brain—that is to say, adherence of the dura mater to the margins of the aperture. This was so. The 'un-anchoring' process was complete and apparently permanent.

Disadvantages of Celluloid Plates.—

*Special Disadvantages.*—The inward sinking or depression of celluloid plates, seen in some cases, more especially those associated with considerable primary brain laceration, might be lessened by the utilization of an outer silver plate; but the silver plates are rather more bulky, less readily adapted to the curvature of the skull in the region of the defect, and less comfortable to the patient. Silver, gold, and aluminium plates are also inclined to yield to the atmospheric pressure and to become depressed. They could, of course, be made so thick as to obviate such secondary changes, but they then become bulky and generally uncomfortable.

*General Disadvantages.*—If the plating is carried out along the lines indicated, these celluloid plates are, in general, fairly satisfactory. For the relief of headaches, fits, and paralyses, they are—as are all plates—useless or harmful. Celluloid plates are readily sterilized; if harmful, they can be removed easily at an early date—with more difficulty later: this is one of the great advantages of these plates over all other methods, more especially over bone-grafts.

From the point of view of protection from further injury, many of my patients are advised to wear thin aluminium shields, covered with cloth and fastening round the head with narrow elastic. Some patients object to these shields because of the attention which is directed towards their head trouble. I point out to them that the shield should be regarded as a shield of honour.

## X. POSTSCRIPTUM.

Since this paper was written as a careful and considered résumé of the remote effects of gunshot wounds of the head, I have been rather perturbed by some recent fatal cases. Before alluding to these disturbing factors, it should be noted that, of 775 fully-recorded cases, 50 died (6·5 per cent). Death occurred, on an average, nine weeks from the date of the primary injury. With one exception, where death resulted from tetanus, the fatal termination was due to meningo-encephalitis. In no case did the autopsy reveal a localized abscess—that is to say, an abscess with well-defined boundary; the abscess, if present, was often loculated and of considerable size, spreading towards the surface of the brain or involving the ventricles.

In 19 of these fatal cases (38 per cent) foreign bodies were present, too deeply situated for removal, and in 22 (44 per cent) the conditions were complicated by the presence of a hernia of the cerebrum or cerebellum. In 12 cases (24 per cent) the lesion was situated in the occipito-cerebellar region.

It would appear probable that, in the 19 cases where foreign bodies were present, the foreign body in itself was not responsible for the death of the patient—42 cases are discussed elsewhere in this article with foreign bodies remaining in the brain, some in the most inaccessible positions, who are alive and well, and 58 per cent of whom are at work of some description. It is noteworthy also that, although 22 cases died with hernia cerebri, yet 35 cases recovered, 30 per cent being at work at the present time.

Again, the fatal termination of 19 cases with foreign bodies retained must in no sense be taken as an argument for more radical early efforts at removal of a foreign body. From a general survey of such cases I think it is clear that the surgeons in France did not err on the side of leniency in their attempts at foreign body removal—whether the opposite was the case, I am unable to offer an opinion.

Although the average duration of life, from the date of injury till death occurred, was about nine weeks, one case lived eight and a half months, being discharged from hospital with a healed wound, and re-admitted two months later with breaking-down wound and hernia cerebri. This case has some bearing on the more recent perturbing cases alluded to at the beginning of this postscriptum.

The more prolonged of the fatal cases gave warning as to their general unsatisfactory condition by (1) persistent headaches, (2) bouts of vomiting, (3) great depression and irritability, and (4) steady emaciation. In some cases the conditions were diagnosed long before death by means of lumbar puncture, and, in the event of positive result, more energetic treatment was at once carried out—repeated lumbar puncture, subtemporal decompression, attempts at the removal of the foreign body, drainage of abscess, vaccines, etc. I was always rather afraid of lumbar puncture—the risk of spreading the infection is so obvious—but in some cases this method of treatment was carried out energetically.

Even when meningo-encephalitis is existent, recovery may still take place, as in the following case of a left temporo-occipital penetrating gunshot wound, with numerous small metallic and osseous fragments in the underlying brain substance, violent attacks of headache, and screaming fits. Streptococci were found in the cerebrospinal fluid on all occasions when lumbar puncture was carried out. Treatment: repeated lumbar puncture and subtemporal decompression for the relief of headaches. Patient recovered and is now seeking to obtain employment. There were some other cases of similar nature.

Now, as to the perturbing factors. Within the last six months I have had under my care, or have been asked to see, four cases where old wounds had 'flared' after having been healed for three to five years—in two cases the men had been doing ordinary work for this time, with no serious disability other than periodic headaches. Then the wound 'flared' just as so many old wounds of the extremities do; the patient rapidly became unconscious, with epileptiform fits, and died, in spite of immediate radical treatment. In three of these cases the autopsy showed meningo-encephalitis, with no foreign bodies retained, and in the fourth case, a non-penetrating wound of the frontal region, there was an old hæmorrhage in the subjacent frontal lobe, with recent extension, and death ensued from status epilepticus.

These four cases, known to me—and there are probably many others of similar nature—lead one to think of the many patients suffering from the effects of gunshot wounds of the head, many of whom have foreign bodies retained in the brain substance. What will be their subsequent history?

---

REFERENCES.

[1] Rawling, "Cerebral Œdema, its Causation and Treatment", *Brit. Med. Jour.*, 1918, May 4; also "War Headaches", *Ibid.*, 1919, April 19.
[2] Warrington, "Intracranial Effusions of Inflammatory Origin", *Quart. Jour. of Med.* 1913–14, vii, 93.
[3] Foley, *Amer. Jour. of Physiol.*; Sachs and Malone, *Ibid.*,; Weed and M'Kibben, *Ibid.*, 1921, 48, 512.
[4] *Brit. Med. Jour.*
[5] Armstrong-Jones, Sir Robert, *Practitioner*, 1921, Dec.
[6] Jackson and Free, *Therap. Gazette*, 1921, Dec. 15.

# THE EARLY SIGNS AND SYMPTOMS OF CHOLELITHIASIS.

By Sir BERKELEY MOYNIHAN, Bart., K.C.M.G., C.B., Leeds.

It has probably been the experience of many surgeons to operate upon cases in which a diagnosis of cholelithiasis has been made, and to fail to find any stones within the gall-bladder.

In such cases, many years ago, I was content to drain the gall-bladder, and I found in a disturbing number of occasions that the bile was sterile. The gall-bladder looked normal in many of them; but many presented those early signs of disease which I now recognize at a glance. In the cases which had been drained, a temporary abeyance of symptoms was almost constantly observed, but a recurrence rarely failed. A second operation was performed and the gall-bladder removed. In 1909 I described "A Disease of the Gall-bladder requiring Cholecystectomy", a disease unrelieved by cholecystotomy, in which the gall-bladder wall itself presented the evidences of chronic or subacute inflammation. There was a denudation or destruction of the villi, with a deposit of lipoid material, especially cholesterin esters, in the stroma of the mucous membrane. To this condition MacCarthy later gave the very appropriate descriptive name of the 'strawberry gall-bladder'. The appearance of the living membrane exactly resembles that of a ripe strawberry, the congested mucosa being studded with brighter yellow dots which end abruptly at the cystic duct.

There are more types of 'strawberry gall-bladder' than one, and the differences probably represent stages of gradual development. In its earliest, but quite definite, form, the mucosa is a little redder than the normal, and the slightly yellow specks show nothing but lipoid material. It is possible, as Professor M. Stewart has suggested to me, that in this stage the gall-bladder merely represents a local phase of the general condition hypercholesterolæmia, and that infection has not yet developed in its walls. In later stages the villi may become denuded of epithelium, and tiny ulcers soon develop upon the surface; or cholesterin crystals, like fine grains of sand, may firmly adhere to, or be embedded in, its walls. In the latest stage the gall-bladder becomes thickened throughout, a firm and copious deposit of fibrous tissue is found in its walls, and calculi are often present.

This experience led to a closer study of the gall-bladder walls, and of the bacterial content of the bile in cases in which cholelithiasis was present, or was suspected; and, as more and more cases have come under review, it has by degrees become clear that there are conditions of the gall-bladder, apart from calculous disease, which cause a close mimicry of the symptoms of gall-stones, and which can be successfully treated only by cholecystectomy. The diagnoses we make of abdominal diseases are often inferences only, and not certainties, however much we may be tempted so to regard them. If a patient suffers from repeated attacks of pain in the upper abdomen associated with a rigor, which is indicated upon the 'steeple' temperature chart; if jaundice, which is always present, deepens after the attack and gradually subsides until the next attack; and if there is a progressive loss of weight: we do not hesitate to diagnose a floating stone in the common bile-duct. But the symptoms are not those of stone, but those of a cholangitis, which may be and usually is provoked by a stone, but which may be provoked by other conditions also, such as a series of hydatid cysts escaping down from the liver (as I have seen twice), or a pancreatic calculus in the ampulla, or a subacute or chronic pancreatitis. So it is, I think, with the diagnosis of stones in the gall-bladder. The condition that provokes the symptoms is an infection of the gall-bladder, set up it may be by stones, but not seldom existing in an early or advanced degree in the absence of stones. The

whole course of these diseases of the gall-bladder or of the liver, associated with gall-stones, is not yet by any means clear to us; but our knowledge is widening little by little, and a broad conception of the whole problem is now possible.

**By what means and through what channels is the gall-bladder infected?**

There are several possible avenues which may be traversed by invading micro-organisms.

1. Infection may Ascend from the Duodenum, along the common and cystic ducts to the gall-bladder, or along the common and hepatic ducts to the liver.—This mode of infection, if it exists at all, is probably very rare. Bond's experiments have shown that pigments introduced into the rectum can soon be recognized in the discharge from the gall-bladder after cholecystotomy. It is certain, therefore, that organisms can travel directly upwards in these reflux currents. But they probably do not, because the duodenum is, as a rule, sterile, and is very rarely infected heavily. The downward current of bile flushes the common duct with a certain regularity.

2. Infection may Descend from the Liver.—Organisms reach the liver by way of the portal stream. As the blood passes round the liver lobules its organisms are caught up by the hepatic cells, which are the great 'destructors', and are rendered inert or killed. Some few may escape with their lives, perhaps at a time when the liver is momentarily overwhelmed by large numbers of organisms. Those which so escape gain access to the gall-bladder, and may form the nucleus of stones, which make haste to develop round them. The portal blood consists of two main streams, one from the alimentary canal and one from the spleen. The view has been generally held that the former is the current along which most of the micro-organisms travel; and this no doubt is true. But remembrance should also be given to the possibility that organisms may be derived from the spleen. The association of diseases of the liver, and of gall-stones, with diseases that seem to have their origin or their chief development in the spleen, has recently become clearer. In cases of hæmolytic jaundice, 60 per cent of the patients suffer also from cholelithiasis; with splenic anæmia, cirrhosis of the liver and gall-stones are both associated. Enlargement of the spleen is noticed in cases of stones in the gall-bladder and the duct, but sufficient regard has not been paid to the possibility that it is from the spleen that the infective agent is immediately derived. There are cases in which a large number of small stones are found throughout the substance of the liver, not only in cases of cirrhosis, but in cases where the liver appears little if at all changed from the normal. And every surgeon is familiar with cases of recurrent gall-stones in which the common duct and all the ducts of the liver within reach are filled with mud and fine stones, which may be washed down in almost unending quantities. In such cases I pass several tubes up into the liver, and apply the Carrel method of intermittent irrigation for several weeks. About ten months ago I operated on such a case in which seven operations had been performed. I dealt with the bile-ducts as I have described, and then removed a spleen that was enlarged to approximately thrice the normal size. Since that time no attacks of pain or jaundice have returned, and as this is by far the longest interval of freedom the patient has had for some years, I am hoping that we may have cut off the source of supply of the infecting organisms to the liver. Splenectomy for recurrent cholelithiasis may be found necessary in similar cases. One of the functions of the spleen is to filter out micro-organisms and toxic substances from the blood-stream, and to send them to the liver for destruction. It may sometimes harbour them, rather than transmit them. Its capacity to do so in syphilis has been shown by W. J. Mayo. Possibly in other infections micro-organisms or toxic materials are held up and passed on only from time to time to the liver, which in this way receives the material upon which gall-stones are deposited.

3. Infection may be Derived from the Blood.—We owe our knowledge on this subject to Rosenow.[1] He found that organisms removed from the gall-bladder, from the bile, from the centre of gall-stones, or from the cystic gland of patients treated by cholecystectomy, contained organisms, chiefly streptococci, which when injected intravenously into animals produced lesions of the gall-bladder, the bile-ducts, and some-

times of the stomach or duodenum. He suggested that such organisms have an 'elective affinity' for the tissues of the like kind to those from which they were originally derived. Such organisms reach the gall-bladder of the animal by the blood-stream, and in the gall-bladder produce lesions exactly comparable to those in the organs from which they were taken. Whether it is the micro-organism that selects the tissue in this 'elective affinity', or whether it is the soil that alone provides the culture medium necessary for the growth of the germs which are scattered everywhere in the blood-stream—the soil selecting the germ—is not a matter of importance. The truth is well established by Rosenow's experiments and by clinical and pathological research in man, that micro-organisms attacking the gall-bladder may reach it through the blood-stream.

The question has been most closely studied in connection with typhoid fever, but the results of the experimental work appear very conflicting. J. Koch,[2] in a patient who had died of enteric fever, found inflammatory changes in the mucous and submucous layers of the gall-bladder. Just beneath the epithelial layer of the villi he found masses or clumps of organisms, apparently those of typhoid fever. No organisms were found on the surface of the mucosa. He therefore drew the conclusion that it was not from the bile that the gall-bladder was infected, but by a process of embolism. In the nests of organisms in the wall of the gall-bladder propagation took place; organisms being liberated and escaping through the mucosa into the gall-bladder to infect the bile. Chiarolanza[3] injected typhoid bacilli into the veins and beneath the skin of rabbits, and described the organisms as forming emboli in the capillaries of the submucous layer of the folds of the gall-bladder. Other observers, among them Girode, have however recovered organisms injected into the veins from the bile descending from the liver.

The investigations of Gosset, Loevy and Magrow[4] show that calculi may originate inside the villi of the mucous membrane as minute collections of cells surrounded by cholesterol. As they grow they detach themselves from the wall of the gall-bladder, and becoming free within its cavity, they increase in size, and press upon each other until they become faceted. In any large collection of stones in the gall-bladder two or more generations may be recognized, groups created in the same period of infection being of almost equal size: the larger the stones the longer their existence. The conveyance of organisms by the blood-stream to the gall-bladder probably accounts for those cases (examples are not very infrequent) in which an acute cholecystitis or appendicitis follows rapidly upon such infections as tonsillitis and influenza; or pancreatitis or orchitis upon an attack of mumps.

4. Infection may reach the Gall-bladder from the Liver by way of the Lymphatics.—The lymphatics of the gall-bladder communicate freely with those of the liver. Affections of the liver, changes in size and changes in the cells, have been noticed very irregularly by most surgeons. It would be well if a note of the size and condition of the liver could be embodied in all accounts of operations for gall-stones. If, along with the gall-bladder, a piece of the liver is removed, it should be submitted to microscopic examination. E. A. Graham[5] noticed in a series of 30 cases that the liver was enlarged in 26. In the remaining four there was definite gross evidence of a previous or existing pathological change in the liver other than an enlargement. Inflammatory changes, chiefly of the nature of pericholangitis, were constantly observed in cases of acute and subacute cholecystitis. Graham suggests that an involvement of the liver is "so frequently an accompaniment of cholecystitis that the association must be practically a constant one."

Sudler[6] has shown the intimate connection which exists between the surface lymphatics of the liver and the lymphatics of the gall-bladder through the attachments of the latter to the fossa in which it lies. The view is held that it is through these lymphatics that the gall-bladder may be infected from the liver, that cholecystitis is secondary to hepatitis. My own experience gives support to this hypothesis. Gross affections of the liver which could conceivably be regarded as antecedent to the gall-bladder infections found at operation are present in less than one-fourth of the total number of cases submitted to operation, and among these must be included all those cases where a splenic

condition could have been responsible for the hepatic enlargement or disease, and those in which these conditions were probably secondary to the gall-bladder disease. But the history of attacks in which enlargement of the liver has temporarily occurred (a sort of œdema or phlegmon) is occasionally to be obtained. In the examination of specimens by the microscope, cases are seen in which the peritoneal and subperitoneal coats are invaded by infection when the mucous and submucous coats are normal. In these cases infection must reach the gall-bladder either by the lymphatics, which is most probable, or possibly by the blood-vessels. When the infection arrives through the blood-vessels, it is the submucosa that is first affected in almost every instance.

The view has also been taken that the pancreatic inflammations which are found associated with cholelithiasis are due to a pancreatic lymphangitis. It is difficult to say with certainty how often the pancreas is affected in cases of cholelithiasis. Conditions such as swelling of the head of the pancreas, or hardening or fibrosis, are very difficult to assess, and mere palpation exposes an opinion based upon it to many errors. My estimate, a conservative one, I think, places the frequency of pancreatic implication in cholelithiasis at 12 per cent. The removal of a tiny portion of the pancreas gives valuable information, but it is not as often practised as it might be. Thiroloix and others have suggested that the free communications of the lymphatics of the gall-bladder and the bile-ducts with those of the pancreas, the whole forming one plexus, explain the origin of pancreatic inflammation secondary to cholecystitis and cholangitis ; and they discredit the previously accepted view that the infection travels by way of the cystic and common ducts. And Deaver has added the weight of his great authority to this teaching. He writes that " most cases classed together under the general term of chronic pancreatitis are at first really cases of pancreatic lymphangitis, the infection being propagated from the gall-bladder and bile-ducts or from the pyloric region of the intestine along their efferent lymph channels, which come into intimate relation with those surrounding and embedded in the head of the pancreas."

We do not know, however, that the infection of the pancreas usually spreads from its surface inwards, rather than from the duct outwards to the body of the gland.

It is true that in cholecystitis the cystic gland is always enlarged, and that in cholangitis the glands along the duct may be so large and so hard as to make the discrimination between them and stones very difficult. In such cases the supra-pancreatic glands may also be enlarged. Nordmann's experiments seem, however, to controvert the view that invasion of the pancreas is primarily lymphatic. If in the dog a ligature is placed around the opening of the ampulla of Vater into the duodenum, the common bile-duct and the upper duct of the pancreas are then directly continuous one with the other. If, after this ligature, a virulent culture is introduced into the gall-bladder, acute pancreatitis develops. If the same culture is introduced and the cystic duct at once ligatured, no pancreatitis develops. In these experiments at least the conveyance of the infection from the gall-bladder to the pancreas is by the way of the ducts, and not through the lymphatics. And probably this is often, if not generally, true of the acute condition in man also.

5. Infection may reach the Gall-bladder by Direct Continuity.—This method is rare. Gastric and duodenal ulcers—especially the latter—may have the gall-bladder adherent to them. The duodenum is sometimes saved from perforation by having the gall-bladder soldered on to its outer surface. I have on many occasions found an inflamed appendix either adherent to the gall-bladder or in closest contiguity to it. Infection may penetrate the gall-bladder from its serous surface inwards in such cases ; but in the aggregate they may be very few in number, and from the point of view of the development of gall-stones they are negligible.

The examination of a large number of gall-bladders shows that infection begins with almost equal frequency on the mucous surface and on the peritoneal coat. From the mucosa it penetrates by degrees deeper and deeper until the elastic coat has disappeared and the muscular coats are at last destroyed. An interesting observation that we have made shows that even an early invasion of the submucosa is often indicated by the develop-

ment beneath the peritoneum of the gall-bladder of a considerable deposit of fat. It would seem as though a warning had reached the serous covering that it must protect the general peritoneal cavity from the impending perforation of the coats of the gall-bladder. A fat deposit fulfilling the like purpose is often seen elsewhere. A gastric ulcer lying on the lesser curvature has often a large mass of fat developed around it; a septic kidney is swathed in thick masses of fat; a chronically infected appendix has a grossly thickened mesentery; diverticula of the left colon are covered with fat; and so on. The deposit of fat in the walls of the gall-bladder, at first along the line of the vessels, but later covering the whole organ, is often the most obvious sign of infection of the walls.

Gall-stones are found only in the later stages of an infection of the gall-bladder. It is not yet certain exactly where they are formed, whether within the cavity of the gall-bladder or in the mucosa. In the majority of cases they are probably formed within the cavity of the gall-bladder, being due to the clumping of organisms in the bile, and to the protective covering of these organisms by deposits of cholesterin. To impress upon students this truth, I told them long ago that "every gall-stone is a tombstone erected to the memory of the organisms dead within it." But the organisms are sometimes buried alive. Llewellys Barker, of Johns Hopkins, records the case of a patient who, at the age of 8, suffered from typhoid fever; at the age of 43 he was operated upon for gall-stones; from the interior of the stones living active typhoid organisms were recovered.

Much has been written of the 'latency' or the 'innocence' of gall-stones, but with one single exception I believe it to be true to say that gall-stones invariably cause symptoms. Not, it is true, those symptoms of advanced disease which alone were described in the text-books of medicine until the present day, but symptoms which are nevertheless sufficiently characteristic.

The one exception to the above rule is concerned with the solitary cholesterin stone which often becomes impacted in the cystic duct. The cause of the formation of this single stone is not yet fully known; but it is I think certain that it is not due, as all other stones are, to infection. Such single stones are found in gall-bladders which show no sign of bacillary invasion, and the bile is constantly sterile; nor can any organisms be found in the centre of the stone. In the later stages, after many severe attacks of pain, the gall-bladder walls may become altered; but such changes are consecutive and not primary. The relationship between this type of stone, and indeed all forms of gall-stone, and the cholesterol content of the blood is not referred to here. It is a matter of the greatest interest and importance, but not immediately relevant to the points I wish to raise.

A single cholesterin stone is an ovoid stone rarely larger than a nutmeg. Its surface is finely granulated; on section it presents a number of radiating marks, like the spokes of a wheel. It contains no organisms, and no other constituent than cholesterin. It is apt to be caught in the pelvis of the gall-bladder at the entrance to the cystic duct, and is sometimes found just beyond the first segment of the valves of Heister. It causes no symptoms until it obstructs the duct, and that is the chief feature which clinically distinguishes it from all other forms of gall-stones. In all of these dyspeptic symptoms are aroused, and may be present for months or years before any obstructive symptom develop.

The first indication of the presence of a single cholesterin stone is always a sudden attack of most agonizing pain, beginning in the epigastrium, spreading across the abdomen, and through to the tip of the shoulder-blade. The patient feels as though transfixed by a knife. The agony is terrible; the patient, unable to breathe (the diaphragm being in spasm), feels as though he would burst owing to the great and intolerable distention. Vomiting may bring relief. Relief, however it comes, comes in an instant. This absolutely abrupt onset and absolutely abrupt cessation of agony are quite characteristic of cystic duct obstruction, and are never seen so plainly in any other condition. When the pain persists for a few hours the gall-bladder may be palpable; the area over it remains tender and feels sore for many days afterwards. These typical symptoms, in the absence of an antecedent dyspepsia, enable a diagnosis of a solitary cholesterin stone to be made with a considerable degree of confidence.

All other stones than this are due to infection, and infection, being present before stone formation, may give rise to symptoms which it is slowly becoming within our power to recognize. They are at present, however, suggestive rather than decisive. They are wholly referable to the stomach. Flatulence and fullness after meals, amounting sometimes to so great distress that a woman takes off her corsets or loosens them ; early satiety during a meal, a feeling that when a small meal is taken the stomach is overfull ; a sudden unaccountable sensation of intolerable nausea, described very often as 'sea sickness', sometimes accompanied by faintness and often by salivation ; a feeling of cold associated with slight shuddering, often coming on with great regularity ; and 'acidity' and 'water-brash' are often mentioned by the patients.

None of these symptoms is severe, and none striking. It is rather in the association and persistence of them than in their individual character that their importance lies. The complexion of patients is often altered, although they do not realize it. After removal of the infected gall-bladder a patient will often comment upon the improvement in the complexion, and remark that it is "as it used to be many years ago". Now and again in such patients a more acute disturbance of health is noted ; pain and distress in the upper part of the abdomen are associated with local tenderness, with swelling of the liver, whose edge becomes more easily palpable, and with a slight increase of tenderness. It is as though the whole liver were affected by a slight, but transient, inflammation. Some months, or years, later an attack of hepatic colic occurs, not with the agony associated with the passage of a calculus, but with the rather more subdued but still sufficiently acute pain that probably indicates the passage of bile which is inspissated by thick mucus. In an intelligent patient these several steps may all be traced.

The first cause of these symptoms is uncertain. In recent years inquiry has been made into the association of cholecystitis and hepatitis. E, A. Graham examined portions of the liver removed with the gall-bladder in the operation of cholecystectomy, and found definite changes therein in 87 per cent of the cases. Now and again a fragment of the liver comes away with an adherent gall-bladder. In all such pieces we have found changes —advanced or slight—in the liver substance, and have attributed them to an extension to the liver from the gall-bladder. But it appears to be not unlikely that in many cases it is the liver that is first involved in the inflammatory process, and that the gall-bladder is attacked later by invasion of its lymphatics or by direct extension. The inaugural symptoms of cholecystitis may be due to lesions in the appendix, the liver, the gall-bladder, or all of these organs. Our present knowledge does not allow us to decide, but it is the stomach that is always blamed.

**Pathology.**—The changes produced in the gall-bladder by infections which reach it through the bile, the blood, or the lymphatics, produce changes that are slight but easily recognizable by the practised eye. Among the earliest of such changes is a loss of lustre and of colour. The surface is dimmed and whiter, the normal blue colour being lost everywhere except perhaps at the fundus ; and the texture of the walls is a little thicker, and suppleness is lost, the elastic layer—as we know by examination of sections—being soon destroyed. A deposit of fat is found beneath the serous surface extending upwards along the vessels first, from the cystic duct. The whole gall-bladder is œdematous, and the fundus may show a patch of thickened and reddened opacity which feels almost like a tumour. The cystic gland is enlarged, and sometimes the glands along the common duct also. The pancreas may be enlarged, more especially towards the head.

The gall-bladder may be adherent to the stomach, or duodenum, or colon. There is, however, an 'adhesion' of the gall-bladder that is normal ; it is in the form of a mesentery attaching the organ to the duodenum on the inner side and to the colon below. It is probably an extension of the mesogastrium to the right. It is easily recognized. Adhesions which bind the gall-bladder to any neighbouring structure are always evidences of an infection which, wherever originating, has spread at last to the parts around. It is probably true to say that every gall-bladder adherent in this manner has pathological changes so advanced within its walls as to warrant its removal.

When the gall-bladder is opened the bile is thicker in consistency and darker in colour than usual. The mucosa may be œdematous and turgid, and deep red or purple in colour. The villi at first are swollen and sodden, but later are smoothed away. The 'strawberry' appearance is commonly seen. In the later stage erosions, ulcers, and diverticula may appear, and little abscesses are sometimes found within the walls. Small shaggy papillomata are not infrequent. I have many times found them so placed that it was possible they had been washed into the cystic duct, and had obstructed it. These papillomata are frequently of a bright yellow colour from the presence of deposited lipoid ; they often possess an extremely tenuous attachment to the mucosa, and must often become detached. It is reasonable to suppose that under suitable conditions they may become the starting-point of calculi. In still later stages cicatricial tissue is found, and the walls appear thick, hard, and sclerosed. So advanced a change almost invariably depends, however, upon the long-continued irritation of gall-stones.

NOTE ON THE HISTOLOGY OF GALL-BLADDER DISEASE, BY DR. O. GRUNER.—A histological study of the walls of the gall-bladder which has been made in 100 cases, has shown that the lesions to be found may be grouped according to their relation to the muscular coat : (1) *Cases showing the chief changes in the mucosa and submucosa ;* (2) *Cases in which the chief lesions appear in the subperitoneal tissues.*

When considered in this way, the channel of infection may be readily seen in the microscopic sections as being either by way of the mucosa or the peritoneum—in the former case presumably through the blood-stream, and in the latter through the lymphatics. In the cases in which the infiltration is all through the coats, that layer which shows the most intense infiltration is presumably the one in which the infection began ; and the *peritoneal* infiltration in these cases is due to the fact that the organisms are making their way through from the mucosa into the subperitoneal layers by means of lymphatic channels. And furthermore, when the whole thickness of the wall is involved in this way, it appears probable that the infection has not been a single event, but has been repeated at least once, and very likely many times. This constitutes 'recurrent cholecystitis'.

1. *Mucosal Infections.*—In these cases the early changes noted are œdema of the folds or 'villi' and the appearance of a certain number of inflammatory cells. As the process increases in severity, the œdema spreads through the muscular wall into the subperitoneal layers, and at the same time there is a gradual accumulation of inflammatory cells in the same direction, and fat spaces make their appearance in the subperitoneal tissue.

Should the inflammation subside at this stage, the gall-bladder may return to normal, regaining its flaccidity and elasticity, though always retaining the tell-tale deposit of fat. But if the process does not come to an end—either because the circulation in the walls is hindered by the presence of stones, or because the invading organisms are of greater virulence—hæmorrhages occur from time to time, and a well-marked cellular infiltration becomes evident, so that the mucosa becomes very thick. Superficial hæmorrhages accompany the formation of ulcers, and the extension of organisms into the walls is accompanied by an interruption in the continuity of the muscle bundles, and a loss of elastic tissue. Once this stage has been reached the viscus can no longer retract, and the damaged muscle cannot attempt to expel its contents. Moreover, the sogginess of the walls makes them incapable of changing their shape ; they can only be distended more and more if bile should happen to enter the bladder still further, or contract by reason of cicatrization.

A still later stage, with yet more advanced tissue changes, is reached when the mucosa is converted into a granulation tissue, all the normal structures having been lost. This is sometimes the effect of double infections of the walls, as for instance by streptococci combined with *B. coli*, or by anaerobic organisms associated with *B. coli*. Sometimes it is the effect of repeated infections by similar organisms each time. This stage may subside by a natural process of organization of the granulation tissue, in which case all structures of the normal wall are absent, and the gall-bladder is composed of a mass of fibrous tissue more or less laminated, and enveloped in dense pericholecystitic adhesions.

2. *Peritoneal Infections.*—The peritoneum becomes thickened by the intense engorgement of the vessels as well as by œdema, and these changes may involve the subperitoneal tissue also as far as the muscularis. In this case the elastic fibres are damaged in an early stage, and a number of changes affecting the mucosa become possible owing to a secondary disturbance of the conditions within the gall-bladder lumen. As the acute phase subsides, a fibrosis and permanent œdema of the outer coats becomes evident. Even here a re-infection may occur and lead to the formation of an extensive granulation tissue replacing the original wall, although the mucosa is still relatively unimpaired. The natural result in such a case would also be the formation of a chronic cicatricial contracted gall-bladder.

In this brief paper I am considering the question of infection alone. But before we can come to any final conclusions with regard to the formation of gall-stones, other

factors concerned are in need of discussion. Among these the most important is that of the cholesterol content of the blood. Dr. McAdam has been working upon this question in connection with some of my cases, and the following note which he has kindly written for me will serve to introduce the subject.

In the course of an investigation into the cholesterol content of the blood in various pathological conditions carried out by Miss C. Shiskin, M.B., and myself, a series of cases of cholelithiasis have been examined, before and after operation. Sixty per cent showed a hypercholesterolæmia, while the remainder gave normal values. The latter cases have doubtless shown an excess of blood cholesterol at one time or another, the gall-stones present being perhaps the relics of a former hypercholesterolæmia.

A subnormal value was found in a number of cases clinically diagnosed as cholelithiasis not included in the above list, since at operation no calculi were found. Although the presence of infection always tends to reduce the cholesterol of the blood, yet a chronic cholecystitis does not appear to reduce the cholesterol content in conditions of cholelithiasis, and a frankly low preoperative value should make one suspect some other condition than cholelithiasis except in conditions of acute infection.

The immediate result of operative treatment is a marked fall in the cholesterol of the blood. This is most marked in cases of drainage of the biliary passages. The effects of the anæsthesia doubtless also play a part, while we have observed in all the conditions investigated, other than cholelithiasis, that operative procedures seem invariably to lead to an immediate loss of cholesterol in the blood.

But it is the cholesterol value of the blood some months after operation that appears to be of practical importance. Rothschild and Rosenthal[7] have distinguished two types of hypercholesterolæmia in cases of cholelithiasis.

1. *Obstructive hypercholesterolæmia*, which is temporary, the cholesterol content of the blood returning to normal with the removal of the obstruction.

2. *Diathetic hypercholesterolæmia*, in which the excess of cholesterol is more or less continuously present. This condition may be intensified by the additional presence in the bile-passages of an obstruction to the completion of the metabolic cycle of the cholesterol. When there is this diathesis, the hypercholesterolæmia persists, even after the removal of the obstruction. Most of the cases, so far examined by us, belong to *Group* 1; a few, however, had a markedly high cholesterol content several months after cholecystectomy. These findings suggest that, in cases which show a distinct hypercholesterolæmia before operation, provision should be made for drainage of the bile in order to deplete the body of the retained lipoids. If a later examination should reveal a persistently high cholesterol content, then further accumulation of cholesterol may be controlled by dietetic measures.

Recent work has shown conclusively that there is no synthesis of cholesterol in the body, and that any addition to the total cholesterol content of the blood and tissues is derived from that present in the food. Free cholesterol is converted into cholesterol esters in the intestinal canal, from which they are absorbed and are distributed by the blood-stream to the body cells. As the result of metabolic activity in the cells, cholesterol is again liberated, carried by the blood-stream to the liver, and excreted into the bile, to be again re-esterized and re-absorbed from the intestinal tract. Thus an interference with this constant cholesterol metabolic cycle through drainage of the bile, in cases of diathetic hypercholesterolæmia, may be of considerable surgical importance.

---

REFERENCES.

[1]Rosenow, *Mayo Clinic*, 1916, 222.
[2]Koch, J., *Zeits. f. Hyg. u. Infectionskrankh.*, 1909, lxxii, 1.
[3]Chiarolanza, *Ibid.*
[4]Gosset, Loevy, and Magrow, *Bull. Soc. Biol.*, 1920, i, 1207.
[5]Graham, E. A., *Arch. of Surg.*, 1921, ii, 92.
[6]Sudler, *Johns Hop. Hosp. Bull.*, 1901, xii, 126.
[7]Rothschild and Rosenthal, *Amer. Jour. Med. Sci.*, 1916, clii, 394.

# A COMPARISON OF CHOLECYSTOSTOMY AND CHOLECYSTECTOMY.

By JAMES SHERREN, C.B.E., London.

This problem can be stated very briefly indeed, for the change in opinion that has steadily taken place in the last few years puts it now almost beyond discussion. It was formerly the custom to remove the gall-bladder only if the surgeon considered it so seriously affected as to interfere with its function, and this decision may have been arrived at on external examination only. In this way many cases of disease remained unrelieved and many stones were overlooked. It is impossible to prove the absence of stones unless the gall-bladder has been opened; inflammatory affections and simple growths are even more easily missed unless this precaution is taken.

Ten years ago, in 100 consecutive operations for gall-stones, I considered cholecystectomy necessary in 29. In my last 100, I carried it out primarily in 94; the other 6 were acute cases in which it was unwise for various reasons to make the attempt, and in two of these I removed it at a second operation three weeks later. This change in practice has been forced upon me by experience.

I wish to state at once that in my opinion the results, both immediate with regard to death-rate and convalescence, and remote in the freedom from complications and absence of recurrence of symptoms, are infinitely superior if the gall-bladder is removed as a routine in the treatment of its diseases. This is not the doctrine to preach to those whose operative interference with the biliary passages is and will be occasional; to these the simpler operation of cholecystostomy is the safer. The skilled surgeon, however, must now justify his choice of cholecystostomy, not that of cholecystectomy.

The disease of the gall-bladder is what we should treat; it is not enough to remove the products of that disease, whether gall-stones or infected bile. I can state emphatically that drainage does not cure chronic cholecystitis.

Cholecystectomy should be the treatment in all surgical diseases of the gall-bladder, as a primary procedure where possible, but in two stages in those cases where the risk to life or the common duct is great. I refer to such cases as acute on chronic cholecystitis, where there is an enormously distended, thickened, and adherent gall-bladder containing pus, acute cholecystitis or stone in the common bile-duct with jaundice. We all try to avoid two operations on one patient whenever possible, but I always remind myself that it is better to have a live patient after a two-stage operation than sign the death certificate for the result of an 'ideal', and that cholecystectomy as a second procedure is infinitely preferable to a plastic operation on the common duct.

The experience which led me to consider cholecystectomy necessary was obtained from the examination of gall-bladders removed at operation and comparative results after a period of years.

It is as unwise to diagnose the condition of the gall-bladder by external examination as it is to say, in the absence of definite *x*-ray evidence, that the symptoms from which a patient is suffering are due to gall-stones rather than a chronic cholecystitis or other cause of biliary colic. I have made it a rule never to tell patients they are suffering from gall-stones, but from inflammation or disease of the gall-bladder. We should endeavour to diagnose the disease, not its results.

In many cases in which external examination of the gall-bladder and examination of the lymphatic glands in the neighbourhood have shown nothing abnormal, cholecystotomy has revealed not only small calculi, but such conditions as that in which crystals

of cholesterin or tiny calculi are embedded in the mucous membrane, chronic cholecystitis of the 'strawberry' type, or the thickening met with in the fundus of the gall-bladder called adenoma. In these a mass of adenomatous material occupies the fundus, occasionally becoming cystic. Seen from its mucous aspect it often shows a curious umbilicated appearance. It is occasionally associated with chronic cholecystitis of the 'strawberry' type. Its presence may give rise, not only to the usual secondary dyspepsia, but to typical attacks of biliary colic, and I have removed the gall-bladder for this condition in seven patients who had no calculi, with cure of the symptoms. I have met with it in several associated with gall-stones, and in two, although the naked-eye appearance was identical with those I have referred to, microscopical examination proved them to be columnar-celled carcinoma. Both have remained free from recurrence, one operated upon nine, and the other two and a half, years ago. Polypoid cholecystitis may also be overlooked if cholecystostomy is carried out. Drainage in cases such as these must fail to cure. All need treatment by removal of the gall-bladder.

It is, however, on the ultimate success of our procedures that we must base our practice. What are the results of the two operations? I do not intend to do more than mention those complicated by stone in the common duct. My figures are small compared with those that could be obtained from many clinics, but all have been carefully followed up.

Taking first the cases of cholecystectomy carried out in the treatment of stones confined to the gall-bladder and operated upon over three years ago, these number 184, with 6 deaths, 3 of which were from lung complications, and include 33 operated on in the acute stage. There has been no recurrence of symptoms in any of these cases. I do not believe that stones, apart from the rare pigment variety in certain diseases of the spleen, form in the common duct after cholecystectomy if that duct is clear at the time of operation.

Taking now the cholecystostomies for stone done during the same period, 152 in number, including 46 acute cases, there were 4 deaths. Of the acute cases 8 have had definite recurrence of symptoms. Of the 106 non-acute no less than 21 have had similar relapses. In 75 per cent of the 29 patients who relapsed, symptoms returned within two years; in the remainder it was from four to nine, and it was while preparing this paper that I have had to operate on recurrences seven and nine years after drainage. I have re-operated upon 18 of these patients. In 3, there was chronic cholecystitis only; in the remainder stones had re-formed. In none were stones present in the common bile-duct, nor were stones found here at the second operation. In addition to these recurrences, 5 patients died within four years of carcinoma, certainly or probably of the gall-bladder. In one I removed the gall-bladder a year later, but the patient died of recurrence in a few months; in another the patient returned in twelve months with an obvious malignant gall-bladder tumour and ascites; another in six months; and 2 died, one two and one three years after operation, of cancer of the liver. In none was the gall-bladder left because of the condition of the patient, but because I did not consider it was grossly diseased, justifying removal. This gives a total of 34 out of 148 survivors in whom the result was unsuccessful after a period of years.

I cannot believe that these figures are exceptional. It is not a difficult task to clear the gall-bladder of stones, and I believe if all cases were followed up as these have been, similar results would be obtained. I have communicated with the patient or his doctor at least once a year and have not lost trace of a single case.

During the period under review, out of 448 primary operations for gall-stones, in 83 I removed stones from the common duct, and in 29 carcinoma of the gall-bladder was found to be so extensive that operative treatment was impossible.

During the same period I also carried out cholecystectomy for disease not associated with stones, in 30 chronic cases without a death and complete and permanent relief of symptoms, and in 9 acute cases with 4 deaths, all cases of gangrene of the gall-bladder.

I have excluded from the discussion those cases in which I removed stones from the common bile-duct, as it is notoriously difficult to be certain that the ducts are clear. It

is my practice, whenever possible, to remove the gall-bladder and, if drainage is necessary, to drain the duct itself. My re-operation rate was nearly three times as great when the gall-bladder was not removed.

I have not attempted to go into theories with regard to the function of the gall-bladder and changes inimical to the well-being of the patient that may result from its removal. I have given you facts drawn from my own clinical experience that to my mind leave no doubt or room for discussion that the correct treatment of gall-bladder diseases, including in that term gall-stones, is cholecystectomy, although in certain cases drainage may be necessary as a temporary measure. Cholecystectomy is safer for the patient, the risk of recurrence is negligible, and the loss of the gall-bladder interferes in no way with his well-being.

# *VISITS TO SURGICAL CLINICS AT HOME AND ABROAD.*

## SOME DUTCH SURGICAL CLINICS.

### THE CLINIC OF PROFESSOR NOORDENBOS, AMSTERDAM.

One of the Surgical Clinics of the University of Amsterdam is situated in the Municipal Hospital at the Binnen Gasthuis and includes 110 beds, together with out-patient departments.

Professor Noordenbos directs this service with the help of four qualified assistants. The large and well-lit operating theatre is specially adapted for demonstration purposes

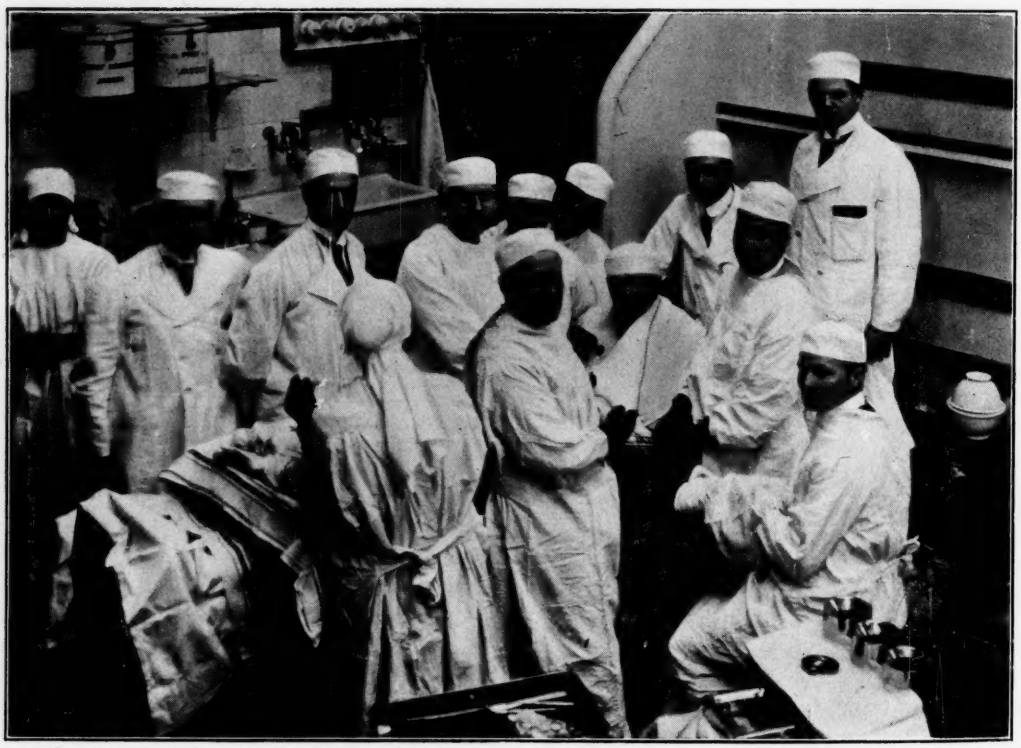


Fig. 110.—Professor Noordenbos in his operating theatre.

by having a number of seats for students arranged in semicircular tiers (*Fig.* 110). In this place he demonstrated his method of treating fractures of the neck of the femur, showing one man of seventy on whom it had recently been performed (*Figs.* 111, 112). A longitudinal incision is made in the outer aspect of the great trochanter, the leg is held with strong abduction, traction, and internal rotation, and a large twist drill is entered on the shaft of the femur 2 cm. below the most prominent point of the great trochanter,

FIG. 111.—Fracture of the neck of the femur (before operation).

FIG. 112.—The same case as *Fig.* 111 (after operation).

directed to the anterior superior spine of the opposite side. Into the hole thus made a portion of the fibula 8½ cm. long is driven, together with its periosteum. The limb is put up in an abduction plaster for three months, and the patient is not allowed to walk for five months. During the later portion of this period—that is, after the removal of the plaster—the patient takes exercise on a little trolley frame which runs on wheels on the bars of a special frame bedstead, sitting on the trolley with both feet on the lower bar of the bedstead, pulling himself down by a cord and pushing himself back by straightening the leg, as is done by a rower on a sliding seat.

Professor Noordenbos has done this operation fifty-four times without failure. He prefers to do it in recent intracapsular fractures, but has performed it with equal success in old cases with pseudarthrosis.

Among other interesting cases demonstrated in the theatre were the following :—

**Resection of the Stomach for Ulcer associated with Internal Hernia.**—A man of fifty-two presented himself with abdominal pain and distention, associated with severe tetany. He had a history of thirty years' dyspepsia, during twenty-five of which he had obtained some measure of relief by washing out his own stomach. The abdomen was opened by a transverse incision on the right side between the sternum and navel. A complicated condition of retrogastric hernia greatly obscured the anatomy of the parts and hid the stomach from view. A number of coils of small intestine had prolapsed through an opening in the transverse mesocolon and then pushed forward the thin lesser omentum, hanging downwards over the anterior surface of the stomach. The hernia having been reduced, a large indurated ulcer was discovered at that point on the lesser curvature which had been crossed by the small intestine, and there was also a tight cicatricial stenosis of the first part of the duodenum. A partial gastrectomy was performed by the Balfour-Polya method.

The patient, whom we saw a week after this operation, was making an excellent recovery.

**Substitution of the Œsophagus by the Jejunum.**—A girl of ten had suffered occlusion of the œsophagus as the result of swallowing caustic potash. Attempt at restoring the canal by bougies having failed, a gastrostomy was performed, and, at a later stage, a loop of 30 cm. of jejunum, having been isolated from the rest of the gut, was attached to the stomach and brought up to the skin in front of the sternum. It was at this stage that we saw the patient, who was awaiting a final plastic operation for the junction of the jejunal fistula to the pharynx by means of a tube of skin, to be fashioned from the chest wall.

**Two Cases of Laryngectomy.**—In both cases the operation had been done for epithelioma and had been performed under local anæsthesia. The trachea had been brought out through a separate incision and attached to the skin. One of these cases of laryngectomy was a young man of thirty-three, who was so pleased with his relief from impending asphyxia, and so delighted to be shown to a party of English surgeons, that he wrote on a piece of paper, " This is our Lloyd George, he does our reconstruction."

We witnessed the following three operations :—

1. **Bone-graft for Spinal Caries.**—(*Operation* 9.15 *to* 9.45 *a.m., commencing twenty-five minutes after the anæsthetic.*) The patient was a boy of seven with caries of the fourth, fifth, and sixth dorsal vertebræ. The disease was in an early stage without deformity. The lesion was beautifully shown by means of a radiogram taken with the assistance of a Bucky-Porter diaphragm. Before the operation the patient is accustomed to lying prone on his face, in which position the operation is done, and this position is maintained throughout convalescence, no other splint or immobilization appliance being used. The patient is nursed on a special narrow mattress the width of the trunk, designed to allow free movement of the arms.

The operation was performed under local anæsthesia by a solution of ½ per cent novocain with adrenalin (novocain 0·5, $K_2SO_4$ 0·4, NaCl 0·7, water to 100, adrenalin 12 drops to 100 c.c.). The anæsthetic was injected both superficially and deeply round

the affected area of the spine and over the tibia from which the graft was to be taken. The process of injection, which occupied about a quarter of an hour, made the child cry bitterly. A curved incision was made on one side of the spinous processes from the third to the seventh dorsal vertebræ. The muscles were separated from the left side of the spinous processes, which were then sawn off from the laminæ by means of a small Fergusson's saw aided by a chisel and forceps. The spines thus separated were left in attachment to the muscles of the right side, and were then pushed towards the right whilst the posterior surfaces of the laminæ were further rawed. The wound was packed whilst

FIG. 113.—Illustrating the suspension method adopted for fracture cases in the Noordenbos clinic.

the graft was being cut. The right leg was fixed at the knee and the tibia exposed by a curved incision. Two cuts were made obliquely into the bone for a depth of about three-quarters of an inch, and at a distance of about five inches from one another, by means of a large bow saw. A number of transverse drill-holes were made from side to side through the whole thickness of the bone between the two saw-cuts, and a piece of tibia including the whole antero-internal surface, five inches long and three-quarters of an inch wide, was removed by a chisel. The actual cutting of the graft occupied six minutes. The graft was placed with its marrow surface next to the laminæ, the spines were brought over it,

and there fixed by deep catgut sutures. The aponeurosis and the skin were separately sutured. The child's colour at the end of the operation was excellent.

2. **Calculus in the Right Ureter.**—(*Operation* 10.16 *to* 10.55 *a.m.*) A woman, age 45, had pain in the right loin, shooting down towards the bladder. The radiogram showed an oval calculus in the position of the right ureter, and this had been confirmed by the passage of a lead ureteral bougie, the point of which was arrested where the shadow of the stone was shown. The anæsthetic was by open ether after preliminary morphine-atropine-scopolamine. An oblique incision 8 inches long was made parallel with Poupart's ligament. The operative field was surrounded by dark blue cloth, and a forehead light used to illuminate the deep wound. The ureter was fully exposed, and lifted up from the point where it crossed the pelvis to the base of the bladder. No stone was discovered, and it was therefore concluded that it must have been dislodged after the passage of the lead bougie. The wound was closed in layers by interrupted silk sutures.

3. **Prostatectomy under Sacral Anæsthesia.**—(*Anæsthetic* 11.10 *to* 11.40. *Operation* 11.40 *to* 11.55.) The patient was a man, age 55, who for some years had had myelitis with incontinence, but for the last twelve months had suffered from retention of urine associated with prostatic enlargement.

Patient lay face downwards on the operation table with his legs flexed at the thigh. A point was taken on each side where the sacrum and coccyx join, and a needle 13 cm. long pushed along the anterior surface of the sacrum, injecting 1 per cent novocain all the time. Fifty c.c. of novocain solution were injected into each side so as thoroughly to infiltrate the nerves emerging from the anterior sacral foramina. The patient was then turned on his back, and the median subumbilical region was surrounded by an anæsthetic injection, this being given first under the skin and then into the rectus sheath. A catheter had been tied into the urethra, and through this the bladder was distended with air. The operator stood at the patient's right side and enucleated the prostate with the left hand, the right being engaged in the rectum. After removal of the gland, which was a symmetrical fibro-adenoma about one inch and a half in diameter, the bladder was drained by a double rubber tube, a gauze pack being left in the space of Retzius. The rest of the wound was closed in three layers, the deep layers and skin by silk, and the fat layer by catgut. The anæsthesia in this case appeared to be perfect.

The silk which is so freely buried, even in the tissues of wounds of doubtful sterility, is prepared as follows: ether one day, 80 per cent alcohol one day, boil half an hour in 1–1000 sublimate, store in 1–1000 sublimate in alcohol.

A short visit was afterwards paid to the wards, and a great number and variety of cases were seen. There were a large number of fracture cases, most of them being treated by a method of suspension and traction, which appeared to be very effective. The limbs were suspended to a metal frame clamped on to the bed. The upper limb was slung in a position of abduction of the humerus with right-angle flexion of the elbow, the limb hanging with the forearm vertical, traction being made on the humerus by transfixion of the olecranon; the lower limb was slung to an anterior wooden bar by means of a cord which was attached to a number of points along the leg by a bandage and brass rings, the whole apparatus being strongly suggestive of a piece of ship's rigging (*Fig.* 113).

## DR. J. SCHOEMAKER AT THE HAGUE.

"Operative surgery is not a sport, it is an art; and just as a violin player plays his sonata with his heart and soul, so the surgeon must perform his operation. This means that the artist does his work not in a hurry, not slowly, but in tempo; . . . it also means that within these laws he is at liberty to do his work in his own way, striving for perfection and beauty, so that the finished product may be a work of art. But the surgeon is not a solo player; he is the first violin of a quartette, the other members of which are his

assistant, his anæsthetist, and his operation nurse." (*Surgery, Gynecology, and Obstetrics*, 1921, Dec., 591, from which journal the accompanying drawings have been copied.)

When Dr. Schoemaker uttered these words before the Clinical Congress of American Surgeons, they were probably regarded as a somewhat high-flown hyperbole, but anyone who watches him at work will be forced to admit that they represent most accurately the actual manner and method of his work.

We saw him do eight major abdominal operations on two successive mornings, and he had selected the particular cases in order specially to illustrate his own methods of performing colectomy and gastrectomy. *Cases* 1, 3, and 6 were instances of colectomy, and it will save repetition if the technique of this operation is described once.

*Case* 1.—(*Operation* 10.15 *to* 11.0 *a.m.*) The symptoms were those of constipation, the patient being a middle-aged woman.

*Case* 3.—(*Operation* 12.5 *to* 12.45 *p.m.*) The patient was a woman, age 28, who had suffered from pain and constipation for eight years.

*Case* 6.—(*Operation* 10.15 *to* 11.0 *a.m.*) A woman, age 63, who had severe bleeding from the rectum, with pain on the right side of the abdomen.

In all three cases there was marked dilatation and mobility of the cæcum and ascending colon. In the last case there was a large inflamed appendix.

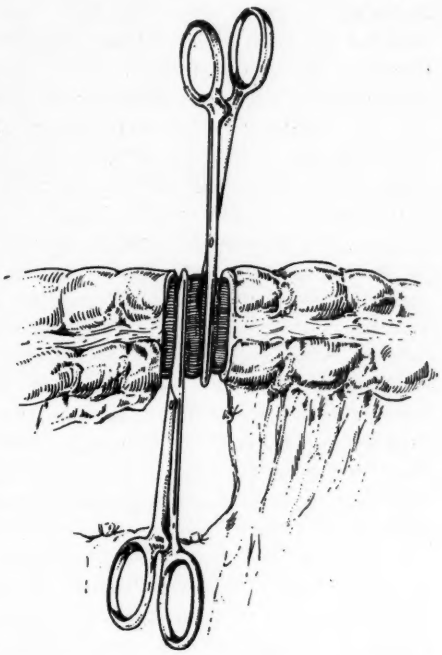


FIG. 114.—Resection of the colon. Position of the clamps.

The abdomen was opened by an incision through the right semilunar line, and the wound held open by a large self-retaining retractor. The ileum was held up in its terminal part, and a hole made in its mesentery. The outer layers of the bowel were divided about three inches from the cæcum, and a cuff consisting of these layers was separated from the mucous

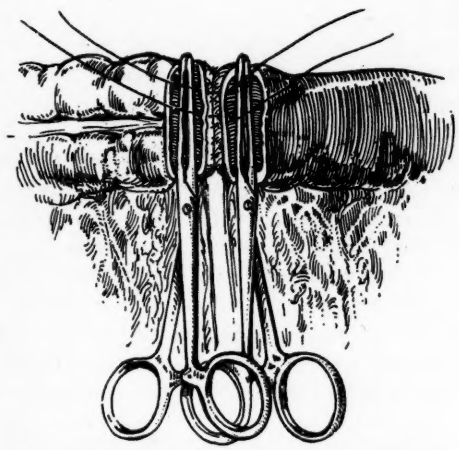


FIG. 115.—Placing the sutures in the serosa.

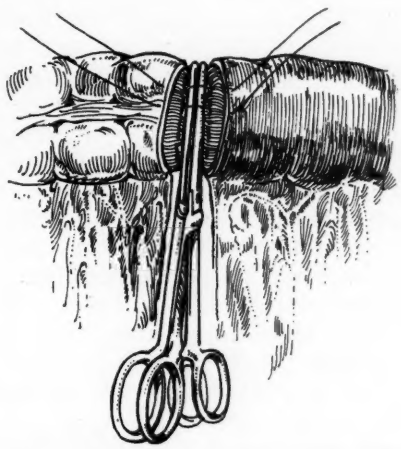


FIG. 116.—Closing the serosa by a continuous suture.

membrane for a distance of about half an inch. The mucous layer thus isolated was clamped by two small forceps, shaped like a Kocher's forceps, but having deep longitudinal grooves on the inner surface of their blades. The bowel was divided between the

forceps. The ascending and proximal part of the transverse colon were separated from the outer leaf of peritoneum and from the great omentum by means of a few touches with the scissors; the main vessels going to the ascending colon and hepatic flexure were clamped and tied in four places. The transverse colon was divided in the same way as the ileum, first by cutting through the outer walls of the bowel and pushing them aside, then clamping the mucous membrane between two forceps (*Fig.* 114), and cutting between these. The separated portion of the bowel was removed, and the ileum brought into contact with the distal portion of the transverse colon, the two portions of bowel being held in apposition by the attached clamps.

It was very noteworthy that after division of the outer wall of the gut, the lumen of the ileum and that of the colon were made of the same size, the former being a little stretched whilst the latter was allowed to contract. An end-to-end anastomosis was made as follows (*Figs.* 115, 116): The assistant held the ends of the gut up in a vertical position by means of the clamps; six interrupted silk stitches united the serous coats of the bowel deep to the forceps and just beyond the edge of the cuff; while a second row of suture united the edges of the cuff, taking also a bite into the mucous layer. The ends of the bowel were then turned towards one another, and the superficial layers of the cuff were sewn together over the forceps. Finally, six more interrupted silk stitches united the serous coat in front of the forceps, the last stitch being tied after the forceps had been withdrawn, so that at no time was the lumen of the gut openly exposed. The edge of the mesentery of the ileum was united by a few stitches to the wall of the transverse colon. The retractor was removed and the abdominal wall closed in three layers of interrupted sutures, the peritoneum and the skin by catgut, and the muscle by iodized silk.

**Partial Gastrectomy.**—(*Operation in one case* 11.15 *to* 12.0 *noon; in the other* 11.10 *to* 12.0 *noon.*) The second and seventh cases were both young women suffering from an indefinite type of dyspepsia. The former had been diagnosed as a case of gastric ulcer, but the radiogram gave no definite evidence of this lesion. The latter case presented symptoms of dyspepsia characterized by hunger pains. In both cases an inflamed and adherent appendix was found and removed after the stomach had been partially excised. In each case the stomach was rather large and prolapsed, the pyloric segment being red, vascular, and irritable.

The abdomen was opened by a median incision from the sternum to the umbilicus, and the wound was held open by a self-retaining retractor. The duodenum was lifted up and the attachment of the omenta clamped and cut in sections. Two small clamps were placed on the first part of the duodenum, which was then divided by the knife. The distal end was covered by gauze, whilst the proximal end was protected by a little metal shield which fitted on to the clamp. The remaining portion of the small omentum was clamped and cut in sections, the coronary artery being divided in the last. A large pair of special clamps (*Fig.* 117) constructed in two portions was then applied to the body of the stomach; the blades of these clamps, which are about five inches long, are curved in about the same shape as the normal lesser curvature of the stomach. When in position the blades extend from a point on the lesser curvature of the stomach opposite to the coronary artery, at the junction of the middle and upper thirds of the stomach, to a point about an inch and a half from the greater curvature of the stomach and two inches from the pylorus. The portion of the stomach between the right end of the stomach clamp and the greater curvature was seized by a pair of small forceps like those for colectomy. The stomach was then cut through by a knife applied close to the clamps, large and small. This freed the pylorus and lesser curvature of the stomach, which were removed. The large stomach clamp consists of two portions. After cutting away the pylorus the distal portion of the clamp is unscrewed and slipped out, thus leaving a compressed edge of stomach wall rather more than one-eighth of an inch in extent projecting from the remaining portion of the clamp (*Fig.* 118). This projecting edge was sewn over by a continuous catgut stitch, and the remaining portion of the clamp was then taken away and a second continuous Lembert stitch completed

the closure of this portion of the gastric wound. The stomach had now been reduced to a more or less tubular structure, the end of which was closed by one small colon clamp. This was brought into apposition with the duodenum, and after two more clamps had been applied proximal to the gastric and distal to the duodenal forceps, an end-to-end junction was effected (*Fig.* 119). The deep surfaces of the viscera were joined by interrupted silk sutures. The terminal clamps were taken off and the whole thickness of the stomach and gut united by a series of interrupted stitches, whilst the anterior layer was completed after the remaining clamps had been removed.

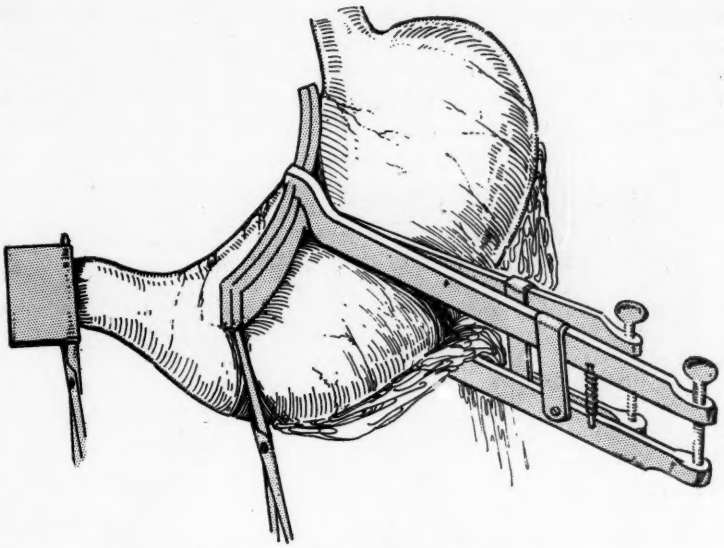


FIG. 117.—Resection of the stomach. Schoemaker's clamp.

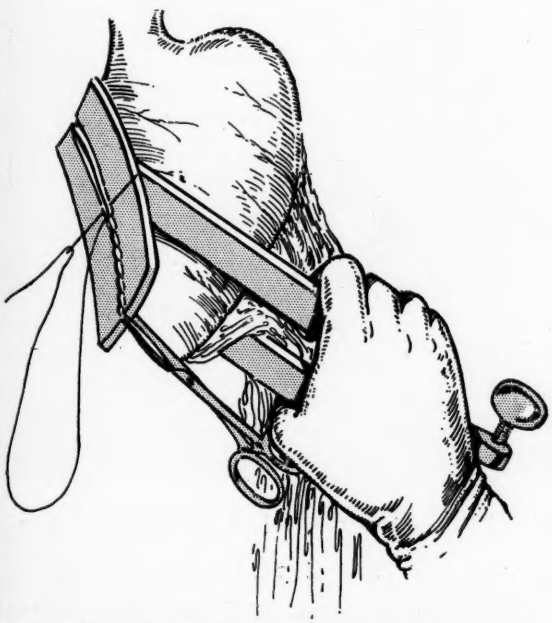


FIG. 118.—Exterior plate of clamp removed, showing narrow strip of serosa secured by a continuous catgut suture.

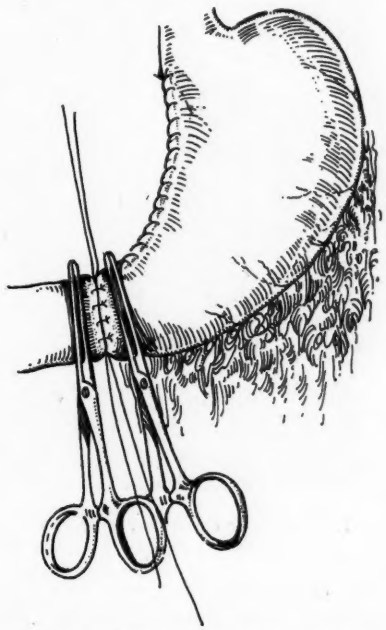


FIG. 119.—Union between the stomach and duodenum.

**Cholecystectomy.**—(*Operation* 12.50 *to* 1.15 *p.m.*) The patient was a man, age 34, who had had symptoms for the last two years. The radiogram showed stones in the gall-bladder. The abdomen was opened by splitting the right rectus muscle; the wound was held open by a self-retaining retractor. A large inflamed gall-bladder was found, with a well-marked membrane between it and the hepatic flexure of the colon. After division of the latter the gall-bladder was separated from the liver by blunt dissection

aided by a few touches with the scissors. The cystic duct was isolated and clamped. An opening was now made into the duct proximal to the clamp, and through this opening a stone was removed from the common duct; a metal sound like a uterine dilator was first passed down the common duct in order to dilate the duct and facilitate removal of the stone from its lower end. The gall-bladder was removed and the opening in the duct sutured by interrupted catgut. These stitches were left long, and threaded through a large rubber drainage tube which was inserted down to the duct. The wound was closed in three layers.

FIG. 120.—The operating theatre in Dr. Schoemaker's clinic, illustrating the position of the patient and the assistants.

**Gastro-enterostomy for Stenosis of the Pylorus.**—(*Operation* 9.40 *to* 10.10 *a.m.*) The patient was a man, age 66, who had been suffering for some time with dyspepsia and vomiting. A provisional diagnosis of cancer of the pylorus had been made because of the absence of HCl, the presence of lactic acid, and the abrupt limitation of the *x*-ray shadow. The abdomen was opened through a median incision and the pylorus found to be densely indurated and adherent, but the appearances were not those of a carcinoma. A retrocolic gastro-enterostomy of the usual type was performed; the stomach was not clamped, but the jejunum was isolated by two separate clamps. The outer row of suture was continuous silk and the inner continuous catgut. In placing the latter, each edge of mucous membrane was pierced twice by the needle so as to leave a loop on the deep surface and produce an infolding of the edge.

**Nephrectomy.**—(*Operation* 12.15 *to* 12.40 *p.m.*) The patient was a stout elderly woman who had had lumbar pains for several years and in whom a radiogram showed a large branching calculus. The kidney was removed through a long oblique incision, and on cutting it open afterwards several smaller stones were found, with suppuration and atrophy which had almost destroyed the cortex.

In all these abdominal operations Dr. Schoemaker maintained the same general arrangement of the table and his assistants (*Fig.* 120). The patient's legs were always lowered, a perineal prop supporting the weight; the instrument table presided over by the operation nurse was placed across the patient's feet. The operating quartette thus faced the patient the whole time—the anæsthetist and instrument nurse at the two ends, the surgeon and his assistant on the right and left side. The three persons engaged in the operation wore rubber gloves, over which cotton gloves were fastened by a rubber band at the wrist; all changed the cotton gloves after concluding any septic stage of an operation such as the opening of the intestine or stomach. The skin was prepared by a strong tincture of iodine, and during the operation there was a notable absence of any packing in of gauze or swabs, complete reliance being made on the efficiency of the clamps. Hæmostasis was remarkably efficient, and a spurting vessel was hardly once seen in the course of the eight major abdominal operations.

## PROFESSOR LAMERIS, UTRECHT.

Professor Lameris has been head of the University Surgical Clinic at Utrecht for over twenty-five years. He has one pavilion in the up-to-date Polyclinic of that town with 135 in-patient beds and a large out-patient department. He has ten assistants for this work.

The operating theatre was large and well lighted, the whole north wall being glass; there is also an arrangement of an arc light which can be reflected by means of mirrors on to the patient. Dr. Lameris uses no antiseptics other than water, soap, and alcohol; gloves are not worn except in the performance of septic operations.

**Radical Cure for Inguinal Hernia.**—(*Operation* 11.7 *to* 11.18 *a.m.*) A young man with a left inguinal hernia. A two-inch incision was made parallel to and above the inner end of Poupart's ligament, the external oblique was divided, the cord was lifted up, the neck of the sac isolated and divided, and the distal end ligatured without removal. The proximal portion of the neck of the sac was twisted a number of times, clamped, transfixed, and ligatured with silk. The stump was dropped back into the abdomen. External oblique and skin were united by two rows of interrupted silk sutures. The patient is kept in bed for about a week. Dr. Lameris said that he had operated upon 1200 cases by this method with satisfactory results. He does not, however, operate upon direct hernias, but treats them by a truss.

**Gastro-enterostomy for Pyloric Cancer.**—(*Operation* 11.22 *to* 11.40 *a.m.*) A man, age 70, with a history of pain and hæmatemesis. The abdomen was opened by a five-inch median incision, and an indurated mass found in the pylorus and lesser curvature of the stomach. A retrocolic gastro-enterostomy was performed, with the assistance of a curious instrument called a gastrophore, invented by Narath, of Heidelberg. It is a kind of clamp the deep blade of which is a convex ovoid and the superficial blade of which is a ring. By means of this clamp the stomach is pressed up against the transverse mesocolon, and a bloodless field secured for the attachment of the jejunum. The anastomosis was made by means of three rows of sutures, each being continuous silk. The abdominal wall was closed in three layers, the deep layer by continuous silk, the aponeurosis and skin by interrupted silk.

**Recurrent Appendicitis.**—(*Operation* 11.48 *to* 12.5 *p.m.*) The abdomen was opened by a five-inch incision through the right semilunar line. The mesentery of the appendix

having been clamped and ligatured, the stump was turned in by three separate sutures. The abdomen was closed by three layers of interrupted silk stitches.

**Nephrectomy for Pyonephrosis.**—(*Operation* 12.10 *to* 12.40 *p.m.*) The patient was a woman, age 26, who for the last month had had a hectic temperature and pus in the urine. On two occasions a catheter had been passed into the right ureter for 16 cm. and the kidney irrigated through this, with a temporary relief of her symptoms.

A ten-inch incision was made through the right lumbar region, the patient lying on an air cushion. The kidney, which was very adherent, was isolated by a blunt dissection and removed together with about six inches of thickened ureter. The wound was irrigated by a solution of hydrogen peroxide, which was drawn off by means of a nozzle attached to a water pump. The wound was closed with buried silk sutures and drained by a large tube.

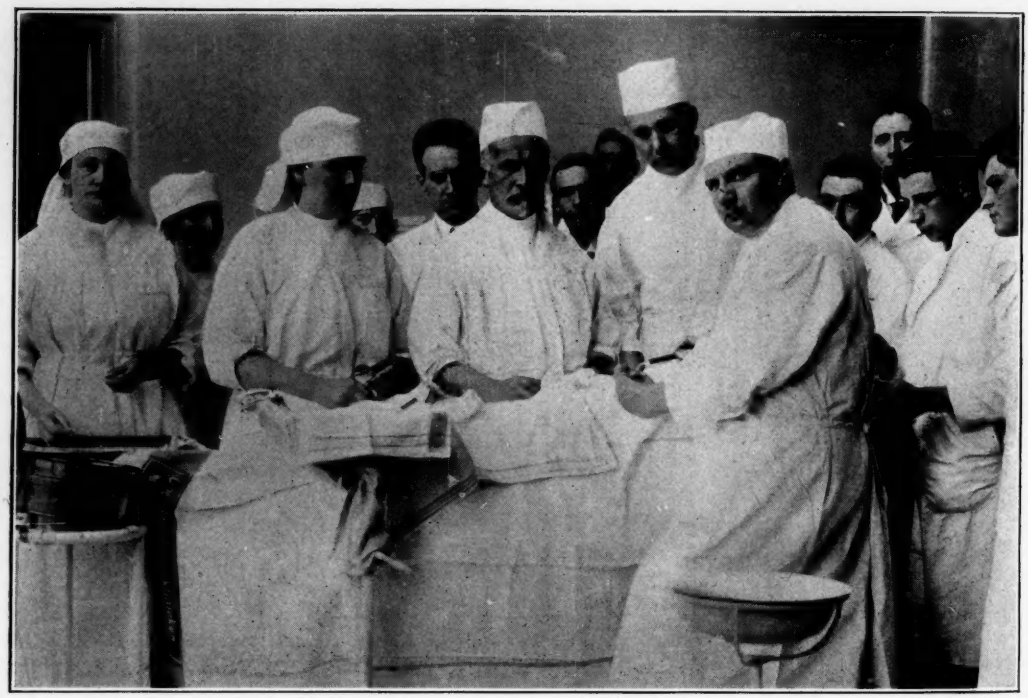


FIG. 121.—Professor Lameris in the operating theatre.

**A Resection of Simple Goitre.**—(*Operation* 9.0 *to* 9.30 *a.m.*) The patient was a woman, age 35, with symptoms of dyspnœa and a large symmetrical goitre about the size of two fists. The anæsthesia was by local injection of ½ per cent novocain. A transverse collar incision was made. The inferior thyroid artery was exposed and ligatured on each side in the space between the thyroid gland on the medial side and the sternomastoid and carotid sheath on the lateral side, by the method of de Quervain. The hyoid muscles were cut across and turned upwards. The superior thyroid vessels were dealt with by ligating the anterior and posterior branches close to the gland. The superior parathyroid bodies were clearly seen on both sides. The isthmus of the gland was separated from the trachea and cut through. The greater portion of both lobes was then resected, leaving a piece of gland tissue on each side about the size of the top joint of the thumb. The cut edges of the remaining portion were then brought together by catgut. The hyoid muscles and skin were united by separate silk sutures, a drainage tube being inserted.

**Resection of Cancer of the Colon.**—(*Operation* 9.37 *to* 11.5 *a.m.*) The patient was a young man, suffering from abdominal pain and constipation and the passage of blood and mucus.

A hard elastic tumour could be felt in the left lumbar region. The abdomen was opened by an incision in the left semilunar line, the tumour being found apparently in the descending colon. As it felt like a polypoid growth and the wall of the bowel was healthy, an incision was made into the bowel, after lifting it up and packing round with gauze. The bowel was opened longitudinally by a three-inch incision, the tube connected with the suction pump being brought into frequent requisition in order to remove septic material. A fungating tumour about two inches by two and a half inches was found to be growing from higher up in the colon, forming the apex of an intussusception. The incision into the gut was temporarily closed by several forceps, and the invagination reduced. After this had been done the tumour was found to be situated in the distal portion of the transverse colon. The splenic flexure together with the contiguous parts of the transverse and descending colon were mobilized by dividing the peritoneum and blood-vessels along their medial aspect.

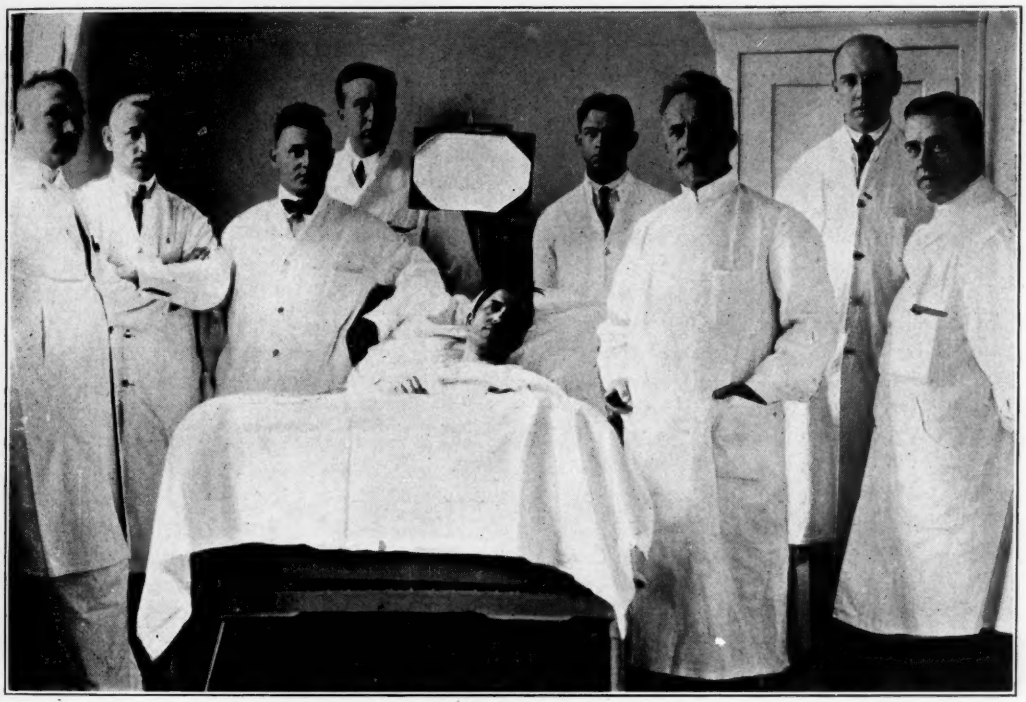


FIG. 122.—In the wards.

A side-to-side anastomosis was made between the transverse colon and the descending colon, using the opening already made into the latter for this purpose. The anastomosis was performed by means of three rows of continuous silk suture. After this had been done, the portion of bowel which lay beyond the anastomosis containing the tumour was removed by two transverse sections, each of which was closed by three layers of silk. Before closing the abdomen it was observed that a secondary growth existed in the liver. The wound was closed without drainage.

**Thoracoplasty for Empyema.**—(*Operation* 11.15 *to* 11.55 *a.m.*) A young man who had suffered from empyema five months ago. This had been treated by aspiration only, and a sinus remained in the posterior axillary line in the ninth intercostal space. A large flap of soft tissue was turned upward so as to expose the whole left lateral aspect of the chest. Five or six inches were then removed from six consecutive ribs, that is, from the sixth to the eleventh inclusive.

The sinus was excised with the actual cautery. A cavity of six inches by three inches was exposed, and a part of its external wall removed.

The wound was flushed with water, and from the bubbling which occurred it appeared that there must be a communication between the empyema cavity and the lung. The wound was closed by interrupted silk sutures, a large drainage tube being left in position.

**Operation for Osteomyelitis.**—(*Operation* 12.8 *to* 12.20 *p.m.*) The patient was a boy, age 18, who for ten days had had pain and swelling in the left thigh, chiefly in its lower third. An incision four inches long was made into the external aspect of the thigh, and a cavity containing pus was discovered at the back of the lower end of the femur. The medulla of the femur was opened by a large electric burr, and pus exuded from this opening, which was then enlarged until it presented a hole three inches long and three-quarters of an inch wide. Two large tubes were passed right down into the bone, and the rest of the wound was lightly packed with gauze.

The whole arrangement of the surgical clinic was that of a very well-equipped modern hospital, with every facility for teaching and research. A lecture theatre in which operations could be performed, a pathological museum, in which the most noteworthy item was a very complete collection of diseases and injuries of the bones and joints, and a department for pathological and clinical research, were some of the most striking features of the surgical unit.

# *SHORT NOTES OF RARE OR OBSCURE CASES.*

## TORSION OF THE HYDATID OF MORGAGNI.

By ALBERT J. WALTON, London.

Mr. G. H. Colt has emphasized the rarity of this condition, and states that in addition to his own recorded case he could only find evidence of the occurrence of one other. The lesion is important, however, in that it closely simulates torsion of the testicle, so that an orchidectomy may be wrongly carried out. Of the rarity of the condition there can be no question. Until Mr. Colt's case was reported I could find no other recorded, although I had met with a case in my own practice in 1913. The account of this is as follows :—

W. W., a boy, age 13, was admitted to the London Hospital on March 10, 1913.

He stated that three days before he had noticed a sudden onset of severe pain in the left testicle while at school. He did not vomit, and his bowels were opened regularly. The pain persisted that night. It had since gradually abated, although the left testicle had continued to be very tender.

Condition on Admission.—The patient's general condition was good. The left half of the scrotum was œdematous and red, the swelling spreading up to the abdominal wall. The left testicle itself was swollen and very tender, and there was diffuse tenderness of the whole of the cord. The testicle could be felt, and apparently the epididymis was situated in the normal position behind. The right side of the scrotum was not swollen, nor was there any tenderness or swelling of the right testicle or cord. The temperature was 98·6°. There was no evidence of any urethritis and no history of mumps. The abdomen moved well, and it was not distended. There was no tenderness of either abdominal ring, and no impulse could be obtained. There were no enlarged glands in either groin.

Operation.—An emergency operation was performed in the belief that the condition was one of torsion of the testicle. An incision was made over the left inguinal canal, the external oblique was divided, and the testicle and cord were drawn up into the wound. The cord was much swollen and œdematous.

The tunica vaginalis was dilated and contained a considerable amount of clear fluid through which could be seen a small object, about the size of a currant, which was black or dark blue in colour. The tunica vaginalis was punctured and the fluid collected in a sterile tube. On opening the tunica vaginalis a large, swollen hydatid of Morgagni was seen. It was attached to the outer side of the testicle, and there was a pedicle about a quarter of an inch long which was twisted in two complete revolutions.

The hydatid itself was tense, swollen, and plum-coloured, and about the size of a currant. The pedicle was ligatured and the hydatid removed. There was no mesentery between the testicle and epididymis, and no evidence of torsion of the cord. The tunica vaginalis was sutured, the testicle replaced, and the wound closed.

The wound healed by primary union, and the boy has since had no further trouble. The bacteriological report stated that the fluid from the tunica vaginalis was sterile.

## PRIMARY JEJUNAL ULCER.

By ALBERT J. WALTON, London.

The frequency of gastrojejunal or jejunal ulcer following a gastro-enterostomy for a pyloric or duodenal ulcer has directed considerable attention to this portion of the intestine. In spite of the care that is given to the technique in the performance of the operative steps, the frequency remains at or about 2 per cent. In the search for the cause much stress has been laid upon the presence of the acid stomach-contents in the lumen of the intestine, and that this is an important factor is shown by the absence of such a complication after a gastro-enterostomy for carcinoma and by its rarity after a similar operation for a lesser-curve ulcer.

The frequency with which unabsorbable sutures have been found in the base of the ulcer leads, however, to the belief that mechanical trauma and errors of technique may also be a predisposing cause.

If these really are causative factors, not only would the complication be expected to occur less frequently as the technique improves, but peptic ulceration should occasionally be discovered in the jejunum apart from operative treatment, for, according to C. A. Roeder[1], contents of marked acidity have been obtained from the distal duodenum by means of a duodenal tube after feeding with a soft mixed meal.

Few such cases have, however, been recorded. In fact, the only case I can discover is one that is reported by Schmilinsky[2] and quoted by Judd.[3] Several other cases may have occurred, but have not yet been reported. The following is such an one :—

E. C., a married woman, age 45, and the mother of two children, was seen on Oct. 27, 1919. She stated that she had suffered with stomach trouble for nineteen years. She would have attacks of pain every day which recurred for one to two weeks, and then she would remain perfectly free for some months. The pain was situated in the epigastrium, passing to the back and to the whole of the abdomen, and much more to the lower part than is usually seen with a gastric ulcer. The pain would come on late after food and would often be relieved by food. Sometimes it would wake her in the early morning, usually at 2 a.m. There had never been any vomiting. The appetite was good and there had never been any hæmatemesis.

The last attack had commenced five weeks before she was seen, and had continued since. The pain had been more severe in character than in the previous attacks, and on the first day it was associated with vomiting. For three weeks she had remained in bed. During this attack she had lost one and a half stone in weight. The bowels had always been constipated, and there had never been any loss of blood or mucus from the bowels.

On physical examination she was found to be a pale and anæmic woman, and looked considerably older than her age. The stomach was not dilated and there was no evidence of ptosis. In the mid-epigastric point a soft ill-defined swelling could be felt which was tender to the touch.

The test-meal revealed free HCl 0·12 per cent, and a total acidity of 50.

The *x*-ray picture showed the stomach somewhat high, being apparently pushed up by a swelling beneath it. The movements were normal and there was no irregularity in outline. The meal passed freely through the intestine, and the swelling, which appeared to push the stomach up, did not appear to be directly connected with the gut.

The abdomen was opened by an upper right rectus incision, the muscle being displaced outwards. The stomach and duodenum, gall-bladder, and appendix were in every way normal ; but on the jejunum about three feet from the duodenojejunal flexure was an inflamed and indurated area about two inches long. Here the wall was injected and thickened, and the omentum was adherent. The mesenteric glands were considerably enlarged. There was no suggestion of growth, and no evidence of miliary tubercle ; neither was there any inflamed area to be seen in the rest of the gut. Six inches of the small intestine containing the whole of the inflamed area was resected. The ends of the gut were closed and a lateral anastomosis was performed. The wound was closed.

The gut on section showed a rounded ulcer with a smooth floor and edges in every way comparable with a chronic gastric ulcer.

Microscopic section showed chronic inflammatory changes only, with destruction of the mucosa and muscle; there were no changes suggestive of tuberculosis or syphilis.

The patient made an uninterrupted recovery, and was discharged from hospital in fourteen days. Before leaving a Wassermann test was taken and was negative.

She was seen at regular intervals and continued to have slight ill-defined dyspepsia for about four months. She was troubled considerably with uterine prolapse, and in December, 1920, an operation to rectify this was performed by Mr. Luker. He tells me he examined the gut at operation and found it had healed perfectly and that there was no trace of any ulceration. Since this time the patient has been seen at regular intervals, the last note being dated Feb. 3, 1922, and it states that she is remaining entirely free from pain. There is no vomiting, she is feeling well, and gaining weight.

REFERENCES.

[1] ROEDER, C. A., "Relation of Surgical Technique to Gastrojejunal Ulcer", *Arch. of Surg.*, 1921, Nov., 622.
[2] SCHMILINSKY, *Münch. med. Woch*, 1910, lvii, 1616.
[3] JUDD, E. S., "Jejunal Ulcer," *Surg. Gyneccol. and Obst.*, 1921, Aug., 120.

## LARGE URETERAL CALCULUS.

BY P. MAYNARD HEATH, LONDON.

THE patient is a male, age 30. When he was 8 years old a calculus was removed from his bladder by suprapubic cystotomy, and four years later an operation for the cure of a right inguinal hernia was performed. In 1917, while in France, he noticed that his urine was turbid. In June, 1921, he passed a little bright blood in his urine and suffered a little pain.

FIG. 123.—Radiograph showing calculus in ureter.

On admission to hospital in October, 1921, the man looked healthy. In the left inguinal region above the middle of Poupart's ligament a cylindrical hard tumour could be felt rising out of the pelvis. The kidneys could not be felt. The urine was turbid, neutral in reaction, and contained pus. A radiograph showed a large shadow in the region of the pelvic portion of the left ureter (*Fig.* 123).

On Oct. 5, cystoscopy showed a greatly dilated left ureteral orifice with a small amount of urine escaping from it. The right ureteral orifice was slightly dilated and discharged urine vigorously. No calculus was visible.

The left ureter was then exposed extraperitoneally by a muscle-splitting incision in the left inguinal region. The ureter was very large, and the calculus was easily felt. A longitudinal incision was made in the ureter on to the upper end of the calculus; some turbid urine escaped and was mopped up. The calculus was seized in forceps and coaxed out of the ureter. In so doing the ureter became partially everted owing to the close contact of the ureter and stone. A sound was then passed up to the kidney and down to the bladder. No further calculus was felt, and the wound in the ureter was closed with three layers of catgut sutures. The abdominal wound was closed save for a rubber dam drain. There was a leakage of serum for two days, but healing was complete in ten days. The daily output of urine averaged 50 oz. The amount of pus rapidly diminished, but the reaction remained alkaline. The man was discharged from hospital on Oct. 25.

On Dec. 25, 1921, and again on Jan. 7, 1922, the patient had attacks of right renal colic, and on Jan. 8 passed a little blood in his urine. On Jan. 16 the urine still contained pus. Cystoscopy, after the injection of indigocarmine intravenously, showed a small calculus in the bladder, copious blue efflux from the right ureter, and a flow of pus and faintly blue urine from the left ureter.

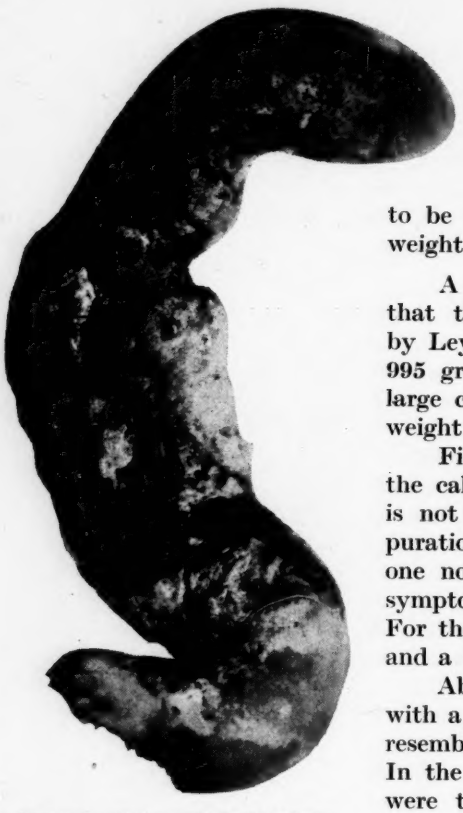


FIG. 124.—Photograph of the calculus. (*Natural size.*)

The main part of the calculus is cylindrical, but there is a beak-like process at each extremity (*Fig.* 124). The length between most distant points is $3\frac{7}{8}$ in., but by making a model and unfolding the curves the total length is found to be 6 in. The greatest diameter is 1 in. and the weight 1075 gr., or 65·8 grm.

A review of the literature from 1913 to 1921 shows that the largest single ureteral stone is that recorded by Ley. It was 3 in. long, 4 in. in girth, and weighed 995 gr.; it was accompanied by pyonephrosis. Other large calculi are described by Specklin, length 11 cm., weight 51 grm.; Péraire, length 9·5 cm., weight 41 grm.

Fisher reports a case in which the *x*-ray picture of the calculus was $4\frac{1}{2}$ in. long. The stone after removal is not described. The kidney was destroyed by suppuration and was removed. The case is similar to the one now recorded in that there had been no urinary symptoms, but vague abdominal pains for ten years. For the relief of these the appendix had been removed and a short circuit of the colon carried out.

Abell removed a ureteral calculus, oblong in shape, with a distinct curve or beak at either extremity, thus resembling the one now described. It weighed 24 grm. In the remarkable case recorded by Collinson, there were two calculi forming a cast of the ureter. The upper stone was rather more than 5 in. in length and weighed 840 gr., the lower was $2\frac{1}{2}$ in. long and weighed 440 gr. The kidney and ureter were removed.

BIBLIOGRAPHY.

ABELL, I., "Giant Ureteral Calculus", *Internat. Jour. Surg.*, N.Y., 1916, xxix, 113; also *Surg. Gynecol. and Obst.*, 1916, xxiii, 33.
BALDWIN, A., "Large Calculus Impacted in Ureter in a Youth", *West Lond. Med. Jour.*, 1915, xx, 113.
BUERGER, L., "Unusually Large Ureteral Calculus", *New York Med. Jour.*, 1914, c, 1103.
COLLINSON, H., "Notes on Four Cases of Ureteral Calculi, in one of which a Complete Cast of the Ureter was Present", *Lancet*, 1913, ii, 1456.
FISHER, M. K., "Report of a Case of Giant Calculus in the Ureter", *Urol. and Cutan. Rev.*, St. Louis, 1919, xxiii, 401.

IMBODEN, H. M., " Giant Calculus in Left Ureter ", *Amer. Atlas of Stereoroentgen.*, Troy, 1917–18, ii, 207.
KELLY, H. A., " A Large Ureteral Calculus Removed through the Open-air Cystoscope ", *Therap. Gaz.*, Detroit, 1920, xxxvi, 305.
LEY, L., " A Large Ureteral Calculus Associated with Pyonephrosis ", *Lancet*, 1920, i, 767.
LOCKYER, C., " Three Ureteral Calculi Removed by Abdominal Section ", *Proc. Roy. Soc. Med.*, Lond. (Gyn. and Obst. Sect.), 1916–17, x, 8.
PÉRAIRE, M., " Calcul géant de l'Urétère ", *Paris chirurg.*, 1916, vii, 220.
POUSSON, " Volumineux Calcul urétéral extrait par l'Urétérotomie ", *Bull. et Mém. Soc. de Chir.* 1917, N.S. xliii, 2000.
ROBERTS, H., " Large Ureteral Calculus Removed by Abdominal Section ", *Proc. Roy. Soc. Med.*, Lond. (Gyn. and Obst. Sect.), 1916–17, x, 3.
SPECKLIN, P. A., " Ein Fall von ungewohnlich grossen Ureterstein ", *Zeits. f. Urol.*, Berlin, 1914, viii, 668; also " A Giant Calculus of the Ureter ", *Amer. Jour. Urol.*, N.Y., 1915, xi, 270.
VINCENT, A., " Les Calculs urétéraux et les Recherches modernes ", *Jour. d'Urol.*, 1921, xii, 321.
WHERRY, G., " An Instance of Large Ureteral Calculus and some other Cases of Calculi ", *Brit. Med. Jour.*, 1913, i, 1043.

## A CURIOUS HERNIA.

BY DUNCAN C. L. FITZWILLIAMS, LONDON.

THE following curious case of hernia seems well worth recording. A patient, age about 50, had double inguinal hernias which were operated upon in 1913. A year later both had recurred, and he had worn a truss since then. The right side had always been worse than the left, and gave him much trouble, as the truss did not control it.

I first saw him in Petrograd, in 1917, and advised that he should be operated upon again as soon as he got home, as the revolutionary times were not the best to choose for an operation.

In November, 1921, he consulted me again about the hernias, that on the right side being particularly troublesome. I gave him the same advice as before, namely, to have them operated upon as soon as convenient. He told me his truss-maker had strongly advised against operation, and had said that they were best left alone, as the rings were too big. The truss-maker was evidently afraid of losing a client, as the rings were not larger than admitted the end of one finger, and, after all, the larger the ring the more difficult is it to control by a truss. As the hernia was always coming down in spite of the truss, and was becoming obstructed and painful and interfering with his work, an operation seemed to me to be highly necessary.

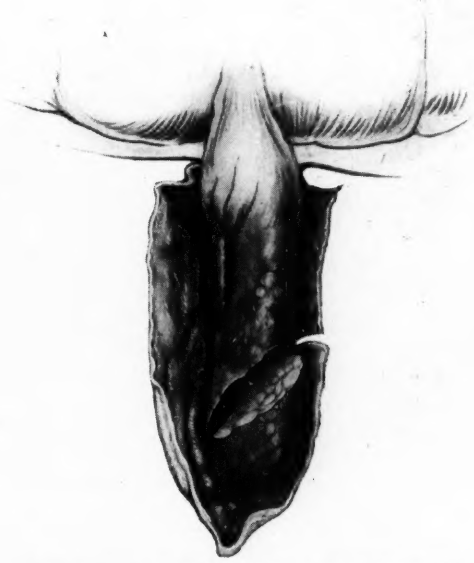


FIG. 125.—The sigmoid colon above, from which hangs the enormously enlarged and engorged appendix epiploica surrounded by the sac.

A few days later I received a wire from him saying that his rupture had strangulated, and asking what he should do.

I wired him at once to call in Dr. Frazer, of Cressage, and wrote to Dr. Frazer. Two days later he came up to London for operation, bringing a note from his doctor to say that he had managed to reduce the hernia. The letter warned me that the doctor thought the patient rather nervous and inclined to make much of the affair. In this I agreed, as he could hardly walk, and complained of great pain down the leg, which he said was a severe sciatica that had come on quite suddenly after the doctor had reduced the hernia. It was with difficulty that he could get into a cab at the station.

Up to this time it had always been the right side which had given him so much trouble,

but this time it was the left hernia. His bowels, which had not acted for some days, had acted very well after a large dose of castor oil, so there was no obstruction. Locally there was some thickening along the site of the sac, which was tender. This was attributed to the fact that he had recently had the strangulated contents reduced. There was no impulse felt.

At the operation the sac was laid bare, quite black, and obviously containing something, and that something black, strangulated, and dead. The neck of the sac was right up against a piece of large bowel, and the long process in the sac was at first thought to be an appendix, though on the left side of the body. Finding that the longitudinal bands did not enter it, the process was ligated and removed, together with the whole sac. On cutting it open the mass was found to have been an enormously enlarged appendix epiploica, which had been attached to the sigmoid colon (*Fig.* 125). Immediately after the operation it was found that the attack of sciatica had disappeared.

The symptoms were not those of strangulation except for the fact that there was no impulse on coughing. The bowels moved well after the castor oil, and the symptoms of very acute sciatica down the left leg were, of course, the reflected pain from the sigmoid colon. The symptoms, in fact, corresponded exactly to those found both in a Littré's and in a Richter's hernia. This curious form of hernia might justly be classified as a third form of hernia involving the bowel in which the lumen of the bowel is not obstructed. We then should have Littré's hernia, Richter's hernia, and this form of hernia all in the same group.

# *REVIEWS AND NOTICES OF BOOKS.*

**Tumours, Innocent and Malignant: their Clinical Characters and Appropriate Treatment.** By Sir John Bland-Sutton, LL.D., F.R.C.S. Demy 8vo. Pp. 806, with 383 wood engravings. Seventh edition. 1922. London: Cassell & Co., Ltd. 30s.

Sir John Bland-Sutton's well-known work has now reached its seventh edition. More than that, it is almost thirty years since the first edition was published (1893), and in these circumstances to review the book at this late date may well appear a work of supererogation. None the less we would like to add our tribute to the great merits of this English medical classic, surely one of the best known and most highly appreciated of all modern medical monographs.

No very radical changes have been effected in the new edition, and the total size of the volume remains practically the same. As in former editions, the strength of the book lies in the great personal experience which the author brings to his task, coupled with the easy diction, the wealth of illustration, and the free use which is made throughout of the facts of development, and of comparative anatomy and pathology. It is an entertaining as well as an instructive work, a real philosophical treatise on tumours.

In the new edition the subject matter has been divided into five main sections: *Group I.*—Tumour-diseases of the connective tissues; *Group II.*—Tumour-diseases of the teeth; *Group III.*—Epithelial tumours; *Group IV.*—Teratomas and dermoids; and *Group V.*—Cysts. The two single-chapter sections of "Endothelioma" and "Tumours arising from the chorionic villi", present in the sixth edition, have now been incorporated in *Group III.* The former chapter on endothelioma has been broken up. The part which dealt with mixed tumours of the salivary glands has been included in Chapter 36, "Epithelial tumours of the pancreas and salivary glands", and the subject matter changed in accordance; while the rest of the chapter, much altered, remains under the new title of "Epithelial tumours of the meninges". In this connection it may be noted that the author's ban has fallen heavily on endothelioma in general. In the sixth edition the index included twelve references under this title; in the seventh edition there is but one—endothelioma of the choroid (Parsons). The classification of tumours is notoriously difficult, and the author has probably taken the line of least resistance in adopting a simple histological one. Even so, we find it hard to understand why all ovarian tumours, as well as tumours of the ductless glands, should be included in the group of "Teratomas and dermoids."

One of the most attractive features of Sir John Bland-Sutton's book is the frequent reference to illustrative cases, drawn both from his own practice and from the literature. Most of the chapters conclude with a list of references to the more important original contributions on each of the subjects dealt with; but in several this is lacking. It is, perhaps, not surprising that the omissions should occur chiefly in those sections of the book in which the author himself speaks with the greatest authority.

The number of illustrations remains the same, but some 20 new ones have been inserted in place of a corresponding number removed. Most of the new figures are good, and several are distinct acquisitions, notably *Figs.* 27 and 28 (multiple exostosis), 165 and 167 (intestinal polypi), and 279 (an enlarged hypophysis, *in situ*). On the other hand, *Fig.* 66 in the new edition (melanosis of the colon) is a poor substitute for the much more typical *Fig.* 69 in the last edition. In general, the illustrations of clinical cases and naked-eye specimens are of the very greatest excellence; but the same cannot be said of the microscopic pictures: many of these could, with advantage, be dispensed with, more especially as no systematic attempt is made to illustrate the morbid histology of new growth.

As is natural in an individualistic monograph, not all the sections and chapters are of equal merit. We would select for special praise the chapters on lipoma, tumours of bone, uterine fibroids, cancer of the breast and uterus, monsters, tumours of the ovary, and hydatid disease. An excellent chapter on adenomyoma uteri is seriously marred by the absence of any reference to the extra-uterine or migratory form of this affection. Even the short paragraph describing a case which invaded the rectum, together with the illustration (*Fig.* 199), has been omitted.

In discussing fibrocystic disease of the testis, the fact of the teratomatous nature of these growths is not referred to, while Sir James Paget's classical case of enchondroma of the testis is only carried as far as Kanthack and Pigg's reinvestigation. The subsequent careful study of this case by Nicholson, of Guy's, and his conclusion in favour of its teratomatous nature, ought certainly to be referred to. This chapter, in fact, illustrates very well the chief defect in the book:

its pathology, in certain sections, is not quite up to date. We hardly think this criticism can be altogether discounted by the title, "Tumours . . . their clinical characters and appropriate treatment".

Only passing reference is made to the use of *x* rays, e.g. in the diagnosis of tumours of bone. Perhaps, in future editions (and we hope there may be many more), it may be possible to insert a few typical radiographs, e.g. of an osteoma, a myeloma, and an osteosarcoma.

In the chapter dealing with the causes and treatment of cancer, we note that the use of Coley's fluid in the treatment of inoperable sarcoma is no longer referred to. Yet good results are still attained.

A welcome feature, adding enormously to the usefulness of the book, is the extension of the index from 12 to 22 pages.

This is a book which will be read with pleasure and profit by surgeons and pathologists, students and practitioners alike, and the new edition can but enhance the reputation of the work and of its distinguished author.

---

**La Lithiase Biliaire.** By A. CHAUFFARD. Large 8vo. Pp. 247, with 26 plates. Second edition 1922. Paris: Masson & Cie. Fr. 20.

IN the preface to the new edition, the author excuses the alteration made in the form of the book in view of the fact that the original spirit is maintained. The only real change in form is an expansion of the remarks which appear in the earlier edition on *x*-ray diagnosis of gall-stones into a complete chapter, whereby the opinion is emphasized that no case should be operated upon until such a diagnosis has been carried out. The use of *x* rays shows: (1) The presence of calculi in about 50 per cent of cases; (2) The presence of a Riedel lobe—which is a sign of gall-bladder disease; (3) The presence of adhesions in nearly 50 per cent of the cases. These three points bear on the indications for operative interference which are given later. The errors possible in *x*-ray work of this kind are freely admitted and discussed.

The real spirit of the book centres round the subject of the pathogenesis of gall-stones. Even more than in the first edition is the significance of hypercholesterinæmia emphasized. Every argument in favour of this causation speaks against the infective theory. He shows that the view that typhoid infection is causally anterior to gall-stones is stultified by a study of cases of disease other than gall-stone disease in this regard. The frequency with which typhoid fever preceded such disease is nearly identical with that met with in cases of gall-stones. The chief new argument in favour of the importance of hypercholesterinæmia is an ethnological one—that the people of Java, like those of Japan, seldom suffer from gall-stones (and then only from pigment stones) and have a remarkably low cholesterin content in their blood as compared with Europeans. It is clear that if the disease is usually dependent on some other cause than infection, one of the arguments for surgical interference is removed, and the plea for vaccine therapy (which is discussed by Chauffard) is nullified. On the other hand, the undoubted occurrence of infection is allowed for as being a secondary event, which sometimes certainly requires surgical intervention (e.g., for suppurative changes in the gall-bladder and adnexa).

Reference is made to a histological study showing how gall-stones can be formed within the mucosa, immediately beneath the epithelium. Drawings are given illustrating the successive steps leading to the production of a calculus lying free within the gall-bladder. Faceted calculi are attributed to this mode of origin. Stones which form within the lumen from the beginning are grouped into those due to (*a*) stasis with excess of cholesterin in the bile, (*b*) infection, (*c*) hæmolysis, with secondary infection.

The chapters on diagnosis and on the clinical effects of cholecystitis upon adjacent organs remain as before, and provide an excellent survey of this subject.

The chapter on treatment occasions surprise, inasmuch as there is hardly a single deviation from the views outlined in the first edition. Dietetic and hydro-mineral therapy are given the first position. Treatment at Vichy and Contrexéville are spoken of highly. It is true that Chauffard allows the advantage of operative interference in cases where the *x*-ray examination shows the actual presence of stones; but even in cases of impaction in the duct he hesitates about interference because of the high mortality (he quotes 43·15 per cent in complicated cases of this kind). He is evidently halting between two opinions when he directs his thoughts to the question of cancerous change in gall-bladder disease, though if he applied the same kind of argument to this topic as he does to the question of post-typhoid cholecystitis he might not have become so alarmed at the high percentage of carcinoma cases in which stones also occur.

He is also evidently afraid of interfering surgically in elderly persons, in cases where there is arteriosclerosis, in cases of obesity, and in cases of emphysema with chronic bronchitis—always, apparently, because the operation would not remove the hypercholesterinæmia factor to which he gives so high a value. Chauffard remarks that the mortality of operations in the early stage, which does not exceed 1 or 2 per cent, is little enough, but is large compared with the mortality of hepatic colic! This quotation perhaps exemplifies as well as possible the partial view of a wide subject taken by the author. A whole series of questions come at once to our lips: Is hepatic colic the only danger? Do catastrophes never occur? Has surgery no claim to relieve suffering as well as to save life?

Though throughout this work a great acquaintance is shown with the early clinical symptoms, where Moynihan is accepted as the authority, and though a good average knowledge of the pathological side of the subject is manifest, there is no evidence that cases are studied on the operation table, where the most valuable of all lessons are learnt. The views on surgical treatment, its scope and results, are therefore only those of an interested amateur.

Apart from special points of this kind, the mere fact of there being only a trivial change in this part of the book itself speaks loudly of Chauffard's low esteem for the surgical treatment of this disease.

---

**Traité d'Urologie.** By G. MARION. Large 8vo. In 2 volumes. With 418 illustrations and 15 coloured plates. Vol. I, pp. 572. Vol. II, pp. 480. 1921. Paris: Masson & Cie. 120 fr.

AT divers times and in sundry places we have read articles on diseases of the genito-urinary organs by Professor Marion and have been struck with his power of expressing himself in clear and forcible language; for this reason we looked forward with a good deal of pleasure to the perusal of this new book of his. We may say at once that not only have we not been disappointed, but that we are filled with admiration at the comprehensive work before us.

The volumes are excellently bound and are handy to hold; the printing is clear, though the type is rather small; the numerous illustrations are most beautifully reproduced and are a great help in explaining the text; especially good are the reproductions of the microphotographs, of which there is a great number; they will be a source of genuine delight to every surgeon who has in him the love of pathology. We think it is not too much to say that the treatise is well worth buying on account of the illustrations alone.

The work is a most comprehensive one and includes the anatomy, physiology, pathology, diagnosis, and treatment (including operative) of the genito-urinary organs and their diseases. As one would expect, Professor Marion is thoroughly up to date, and the reader will find most of the recent work in this field discussed in his pages. The book appears to have been most carefully read over, and misprints are conspicuous only by their absence.

We feel no doubt that these volumes will at once take their place amongst the standard works of surgery, and we hasten to offer the learned author 'mille félicitations' on his admirable and lucid treatise.

---

**The Practice of Urology: a Surgical Treatise on Genito-urinary Diseases, including Syphilis.** By CHARLES H. CHETWOOD, M.D., LL.D., F.A.C.S. Third edition. Royal 8vo. Pp. x + 840, with 300 illustrations and 9 coloured plates. 1921. London: Baillière, Tindall, & Cox. 42s. net.

THE author of this book, in his preface to this edition, states that he still retains the position expounded in the original edition with regard to the problems met with in the domain of urology; this may be defined as the 'progressive-conservative attitude'. Whilst thoroughly agreeing with the author that this is the scientific ideal at which one should aim, we think, after reading the book, that the contents are inclined to weigh down the balance on the conservative side.

The volume is well bound and clearly printed; there are numerous illustrations, most of which are helpful; and the views on urological surgery therein set forth are such as most English surgeons will agree with.

We think, however, that the author's opinions and statements do err in many instances on the conservative side; there is very little in the book that is new, and it is sometimes hardly up to date. If we may give a few instances that have particularly struck us: under the discussion of infections of the kidney by the colon bacillus, there is no mention of the treatment by alkalis; whilst mentioning numerous injections for use in taking pyelographs, the author omits to point out the value of sodium bromide; and the article on the treatment of prostatic hypertrophy is silent on the recent work by German surgeons on the developmental anatomy of this condition.

There is an astonishing picture on page 11 (*Fig.* 4); it is labelled, "Anatomy of upper and lower urinary tracts (After Poirier)". In it the renal vein on the left side passes *behind* the aorta on its way to the inferior vena cava; we have not been able to find this figure in the original work, but, from the fact that the left renal vein in this illustration joins the inferior vena cava opposite the third lumbar vertebra and runs obliquely downwards instead of transversely, we should imagine that this is a case of an abnormality; there is nothing in the text to indicate that the author considers this to be so, and the illustration, as it stands, is most misleading.

We would suggest that the whole volume, which shows by its comprehensiveness that the author must have spent much labour in its compilation, would be vastly improved if it were carefully read over before another edition is published; there are numerous mistakes in the grammar and punctuation which set the reader's teeth on edge; some of the illustrations have many lines leading out to the side which were undoubtedly intended to be explanatory, but, as the author has omitted to letter them and gives no explanation of them in the subscription or in the accompanying text, they fail to enlighten the reader.

**Blood Transfusion.** By Geoffrey Keynes, M.A., M.D. Cantab., F.R.C.S. Eng., Second Assistant, Surgical Professorial Unit, St. Bartholomew's Hospital. Demy 8vo. Pp. 166 + viii, with 13 illustrations. 1922. London: Oxford Medical Publications. 8s. 6d. net.

This work gives a connected account of the whole subject of blood transfusion and of the problems arising from it, together with practical instructions for performing transfusion by an efficient and simple method.

The medical profession, physicians and surgeons alike, will welcome this book, for blood transfusion is of rapidly growing importance in modern therapeutics, and the subject has hitherto only been represented in the medical literature of this country by isolated communications concerning special points.

The book is a handy, concise exposition of the subject, consisting of seven chapters and an excellent bibliography, which contains references to nearly all the contributions of importance published up to the present time.

Chapter 1 gives an historical sketch, showing that blood transfusion is no new subject, though technical difficulties rendered it almost obsolete until quite recent years. The enormous concentration of thought demanded of the medical profession by the great War gave a tremendous impetus to the solution of these difficulties, which were largely those of: (1) Agglutination problems: these are dealt with in a very clear and thorough manner in Chapters 4, 5, and 6. (2) Technique: in Chapter 7 the principal methods are reviewed, and a simple and efficient technique is fully described. Of the two great problems, the second could scarcely be made easier than it is by the method the author has used so extensively, though we think he has rather overrated the difficulties of giving blood by syringes. Using 100-c.c. syringes it is quite easy for a single operator to give a pint or more of blood with the aid of a nurse to wash the syringes between use.

The problem of how to overcome agglutination also has been materially advanced through blood grouping; an excellent account of the subject is given, but we are only on the threshold of this large question. As the author points out, the possibilities in connection with blood grouping are far-reaching, and may be found, amongst other things, to have significance in classifying human beings in their relation to disease tendencies.

Chapters 2 and 3 set out the indications for blood transfusion, and we are pleased to note that the author pays particular attention to the value of this as a means of improving a patient's condition prior to operation. In addition, shock and hæmorrhage as well as hæmorrhagic diseases are reviewed in their relation to this subject.

The book is one which all medical men should possess. Blood transfusion is a therapeutic remedy with which no one can afford to be unfamiliar, and the subject could not be dealt with more intelligibly, concisely, and practically than it is in this work. Moreover, the references at the end of the book make it easy for those who wish to go more deeply into the subject to gratify their desire.

---

**Zur Hundertjährigen Geschichte der Chirurgischen Universitätsklinik zu Königsberg i. Pr.** By Prof. Dr. Martin Kirschner. Roy. 8vo. Pp. 88, with 37 illustrations and 3 plans. 1922. Berlin: Verlag von Julius Springer. In Germany, M. 36. In England, 4·35s.

Prof. Martin Kirschner gives a short but interesting account of the development of the Surgical Clinic attached to the Albert University at Königsberg. It began humbly in 1814 with six beds for surgery and twelve for medicine when the Albert University had only six students. It was fortunate in obtaining a succession of Directors many of whose names became household words in surgery—Unger, Seering, Albrecht Wagner, von Bergmann, Schönborn, Miculicz, Heinrich Braun, von Eiselsberg, Garré, Lexer, Payr, and Friedrich followed in succession, and raised the reputation of the faculty to a very high pitch of excellence. Prof. Kirschner shows how the advances were made, giving portraits of his predecessors and plans of the buildings from the time the clinic was unable to gain the entire possession of a cottage—because its owner was living in it—until it attained its present well-built and well-equipped establishment.